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Old Series Vol. XVI | CONTINUATION OF THE BULLETIN OF THE NORTHEASTERN BIRD-BANDING ASSOCIATION | New Series Vol. XIII

BIRD-BANDING

A Journal of Ornithological Investigation

Vol. XIII October 1942 No. 4

PUBLISHED FOR
THE NORTHEASTERN BIRD-BANDING ASSOCIATION
THE EASTERN BIRD-BANDING ASSOCIATION
AND
THE INLAND BIRD-BANDING ASSOCIATION

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BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. XIII OCTOBER 1942 NO. 4

NOTES ON A NESTING COLONY OF WESTERN CROWS

BY JOHN T. EMLEN, JR.[1]

THE WESTERN CROW (*Corvus brachyrhynchos hesperis*) is a gregarious bird even during the nesting season. In California, occupied nests are rarely built in adjoining trees, but several dozen or more pairs often breed together in a loose association in an orchard or grove. Such a "breeding colony" has been present on the Straloch Farm, 3 miles west of Davis, Yolo County, California for several years. Observations on nest construction, laying, incubation and growth of nestlings were made in this colony during the spring of 1942. The study, as initiated, was incidental to the collecting of eggs for experimental use, and consequently was not planned in the most suitable manner for a life-history investigation. Certain statistical information on crow nesting, however, was obtained which seems worthy of record. A total of about 140 hours was spent in the colony on 55 visits between April 7 and June 13. Nine additional visits were made in late June and July. Notes on the condition and contents of each of 111 nests were made at appropriate intervals with an average of 9.6 visits per nest. Direct observations on courtship and breeding behavior were not attempted.

The colony site was a 108 acre orchard of English walnuts on black walnut stock. The trees, 11 to 17 years old and generally from 20 to 30 feet in height, were spaced in rows 30 feet apart or thinned to form diagonal rows 42½ feet apart (fig. 1). An avenue of large black walnuts, paralleling highway U. S. 99, bounded the orchard on the north; open fields lay to the east and west and a young peach orchard to the south. Most of the surrounding country was in grain and field crops.

A total breeding population of about 60 pairs of crows inhabited this orchard during the nesting season of 1942. The 111 occupied nests found probably represent about 95% of the actual total. This large number of nests, almost two per pair, was in part due to egg-robbing by the observer and the consequent frequency of

[1] Contribution from the Division of Zoology, University of California, Davis, California

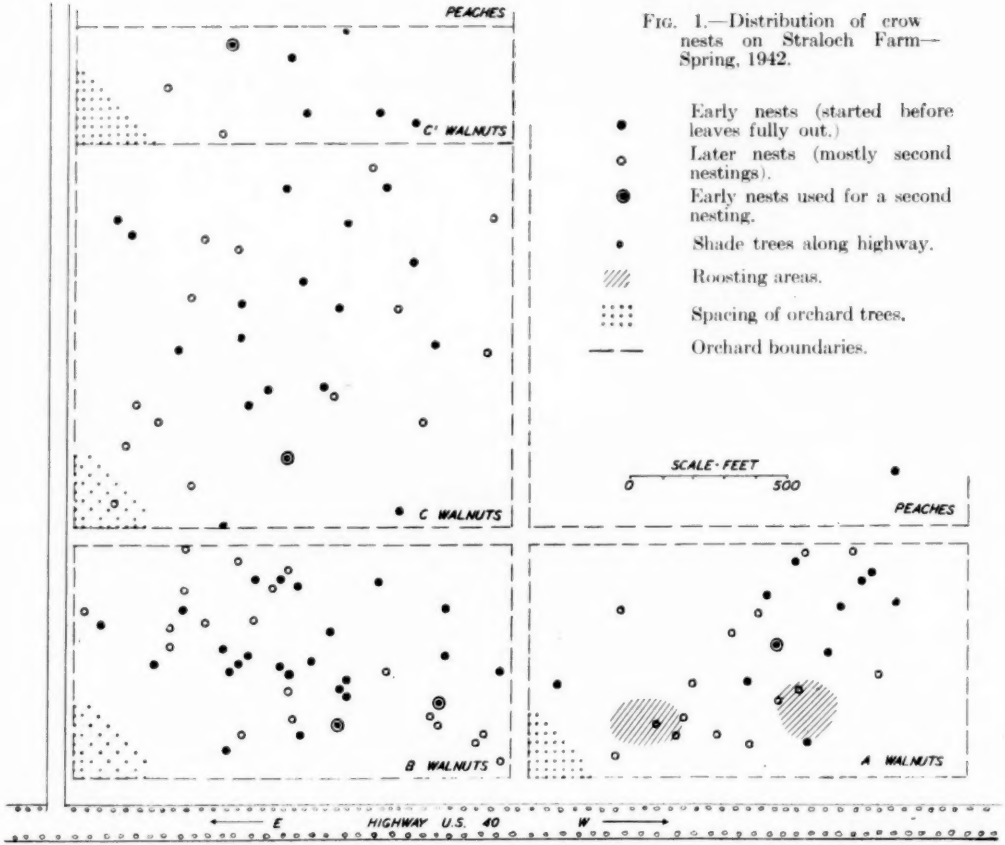

FIG. 1.—Distribution of crow nests on Straloch Farm—Spring, 1942.

- Early nests (started before leaves fully out.)
- Later nests (mostly second nestings).
- Early nests used for a second nesting.
- Shade trees along highway.
- Roosting areas.
- Spacing of orchard trees.
- Orchard boundaries.

TABLE 1

EXPERIMENTS WITH REMOVING AND ADDING EGGS DURING THE LAYING PERIOD IN 36 MANIPULATED CROW NESTS WHICH SURVIVED INTO THE INCUBATION STAGE

Nest Number	Days of Laying Period on Which Eggs were Laid (•) and on Which Removals (−) or Additions (+) were Made						Total Eggs Laid	Eggs in Nest at End of Laying
	1st	2nd	3rd	4th	5th	6th		
2	•	•	•	•−2	•−1	....	5	2
6B	•	•−1	•−1	•−1	•−1	....	5	1
8	•	•−1	•	•	•−2	....	5	2
9	•	•	•−2	•−1	•−1	....	5	1
10	•	•−1	•−1	•−1	....	....	4	1
11	•	•	•	•−4	•	•	6	2
19	•	•−1	•−1	•−1	....	....	4	1
23	•	•	•	•	−3	•	5	2
29	•	•	•	•−3	•	....	5	2
33	•	•	•	•−3	•	....	5	2
36	•	•−1	•−1	•−1	....	....	4	1
38	•	•	•−1	•−1	....	....	4	2
40	•	•	•−2	....	....	....	3	1
47	•	•−1	•	•−1	....	....	4	2
51	•	•	−1	•−1	•−1	•−1	5	1
59	•	•−1	•−1	•−1	•−1	....	5	1
61	•	•−1	•−1	•−1	....	....	4	1
62	•	•−1	•−1	•−1	•	....	5	2
63	•	•−1	•−1	•−1	•−1	....	5	1
65	•	•−1	•	−1	•	....	4	2
67	•	•−1	•−1	•−1	•	•	6	3
70	•	•−1	•−1	•−1	•−1	....	5	1
72	•	•−1	•−1	•−1	•−1	....	5	1
73	•	....	•−1	•−1	•−1	•−1	5	1
75	•	•−1	•−1	•−1	....	....	4	1
76	•	•−1	•−1	....	•−1	....	4	1
81	•	•−1	•−1	....	....	....	3	1
82	•	•−1	•−1	•−1	•−1	....	5	1
85	•	•−1	•	•−2	....	•−1	5	1
86	•	•−1	•−1	•−1	•−1	....	5	1
96	•	•−1	•	•−2	•	....	5	2
32	•	•−1	•−1	•−1	+4	•	5	6
77	•+3	•	•	•	....	....	4	7
78	•+1	•+1	•	•	....	•	5	7
91	•+4	•+1	•	•	....	....	4	9
94	•+4	•	•	•	....	....	4	8

second nestings. Nests were widely scattered through the orchard. Early nests, constructed before the leaves had fully opened, were somewhat more centrally located in the orchard (mean of 12.2 trees from edge) than later nests (mean of 8.8 trees from edge). Concurrently occupied nests averaged about 250 feet apart, but in seven instances were only 80 to 90 feet apart.

No direct observations were made on social or territorial behavior, but the spacing of nests suggested territory recognition. Community

relationships were demonstrated by the flocking and general excitement of from four to forty crows whenever an unusual disturbance occurred. Most of the birds roosted together at night in a group of about forty trees in the colony. On June 3 the roost site was shifted 500 feet to the west but still within the colony confines. Other crows from the neighborhood joined this roost during late May and June, swelling the nightly assemblage to about 300. Several occupied nests were located within the roosting areas; the distribution of droppings on the ground indicated that roosting birds avoided the immediate vicinity of a nest but often perched on the opposite side of the same tree.

Laying season.—The first eggs of the season were deposited on April 6. Laying reached a peak between April 17 and 20, then declined, the last set found being laid June 2 to 4. Authors generally agree that a crow raises only one brood a year, but often renests after the destruction of the first set of eggs. In the present study, most of the laying after April 29 probably represented renesting (fig. 2). A new nest was usually built for the second set, but in five instances the same nest was re-used after an interval of 10 to 12 days (ave. 11.6 days). Three of these five nests had been completely emptied of the first set by the collector, one retained one egg and the other, three eggs. None of these first sets had been incubated. A comparison of nest records and eggs suggests that new nests for second sets were sometimes built within 200 feet of the first nest with an interval of from 10 to 15 days between the completion of the first set and the starting of the second set, but as individual birds were not marked for definite identification, more accurate information is not available.

Nests and nest building.—Eighty percent of the nests were 15 to 24 feet above the ground and about $\frac{3}{4}$ths of the height of the tree in which they were placed. The highest nests were 28 to 29 feet from the ground, the lowest only $6\frac{1}{2}$ feet. About one third of the nests were in basal crotches or on branches more than two inches in diameter. Most of the nests constructed after the leaves had opened were "peripheral," often in small terminal branches.

Old nests or nest platforms of previous seasons formed the foundation for 13 and possibly 17 of the 111 nests. Such nests were supplemented with new rims, mud floors and linings.

New nests varied in structure and size. Most of the early ones had basal platforms and frames of stout sticks mixed, in varying degrees, with fine twigs and grasses. In later nests the foundations were often entirely composed of fine twigs and grasses. Mud was used in most of the early nests, forming a hard firm floor which, during spring rains, proved to be quite impervious to water. Later nests generally contained little or no mud, possibly because it was

then not available locally. A lining of bark shreds, fine grasses, wool, hair, etc. was present in all but four of the nests.

The progress of nest construction was arbitrarily divided by the observer into seven stages of approximately equal duration, identified on the following basis: (1) handful of twigs or grasses; (2) loose platform; (3) loose cup; (4) completed cup with traces of mud; (5) mud floor completed; (6) lining material added; (7) lining completed and smoothed. Most of the early nests could be traced through these seven stages, but later nests frequently omitted stages 4 and 5, and in four instances, stages 6 and 7. The elapsed time from the beginning of stage 1 until the laying of the first egg varied from about 7 to more than 17 days. The entire construction from stage 1 to stage 7 was followed in only six nests, all first nestings; these required from 11 to 17 days (ave. 13.0 days). Nests completed before April 30 (excluding one, quite definitely a second nest) progressed at the average rate of one stage in every 1.86 days, suggesting a total construction period of about thirteen days for first nestings. Nests completed on or after April 30 (excluding one started before April 13) advanced one stage every 1.27 days suggesting a total average construction period of about nine days for second nestings. Eggs appeared before the nest had been completed in three instances and in one of these nest building continued for three days. Building activity ceased with the laying of the first egg in all other nests and apparently was not resumed even when the structures were falling apart.

Eggs and egg laying.—In 14 undisturbed nests the average number of eggs laid was 4.50; in 43 nests partially robbed or otherwise manipulated but allowed to advance into the incubation stage, the average was 4.40 eggs. In this total of 57 nests one had 2 eggs, six had 3 eggs, nineteen had 4 eggs, twenty-nine had 5 eggs, and two had 6 eggs. Twenty-eight sets started before April 30 (excluding one probably a second nesting) averaged 4.39 eggs, whereas twenty-nine sets started on or after that date averaged 4.52 eggs. Two very late sets started May 26 and June 2, possibly third nestings, contained 3 eggs each.

Eggs varied in color from almost immaculate sky blue to heavily blotched dark green, and in shape from blunt, 2.81 mm. x 3.64 mm. to elongate, 2.73 mm. x 4.18 mm. Weights of 157 fresh eggs ranged from 12.5 grams to 21.3 grams and averaged 16.6 grams. Eggs of a set usually resembled each other in color, shape, and size, although the last of a set was generally somewhat smaller and less heavily pigmented. In ten sets for which complete weight data were recorded the first egg averaged 17.1 grams and the last 15.7 grams; in only two sets was the last egg larger than the first. Eggs of first and second settings were about equal in size. Ninety eggs from nests where laying started before April 30 averaged 16.6 grams; sixty-seven eggs

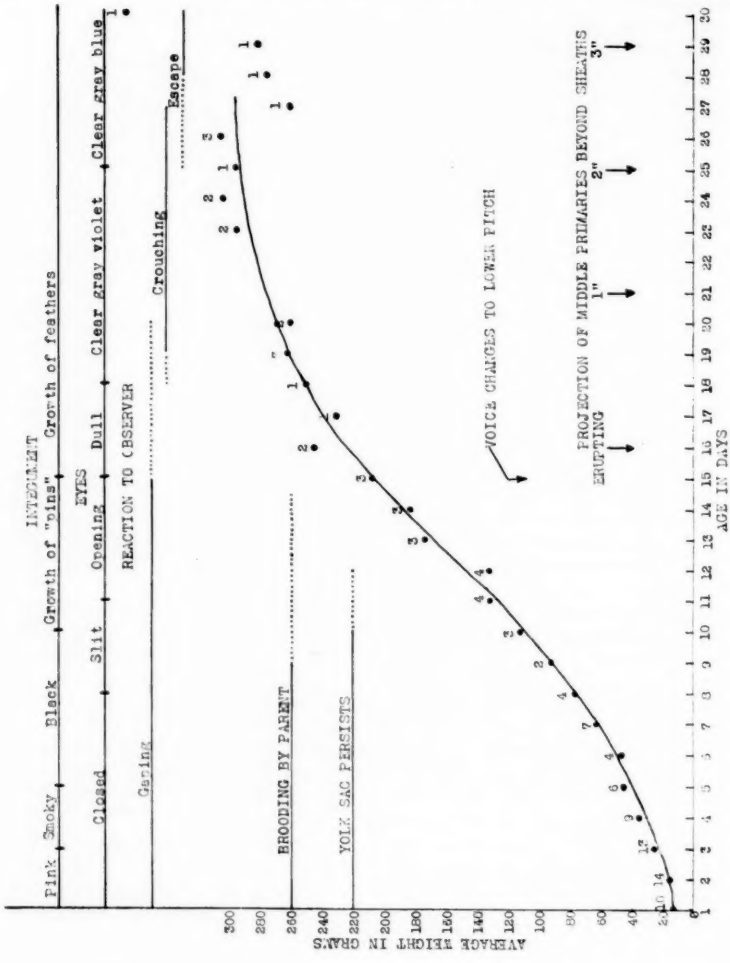

FIG. 3. Development of nestling crows. Figures over weight records indicate number of measurements included. Weights of inaccurately aged birds and of strongly aberrant individuals are not included.

from later nests also averaged 16.6 grams. Eggs in small sets were slightly heavier than those in large sets. Three 3-egg sets averaged 51.2 grams or 17.1 grams per egg; ten 4-egg sets averaged 66.7 grams or 16.7 grams per egg; three 5-egg sets averaged 82.4 grams or 16.5 grams per egg.

In 43 nests the eggs were laid at the rate of one per day; in 14 nests an extra day intervened, generally (ten instances) just preceding the last egg. Most of the eggs were laid in the latter part of the morning.

Removal or addition of eggs in the nest during laying had little or no effect on the duration of the laying period or the number of eggs

TABLE 2

FATE OF 18 BROODS OF CROWS WHICH FAILED TO SURVIVE THE NESTLING STAGE

Nest No.	*Nest Contents*		*Approx. Age of Nestlings*	*Condition of Nestlings*	*Fate*	*Corollary Conditions*	*Presumed Cause*
	Yg.	*Eggs*					
108*	1	0	7–9 days	poor	Yg. disappeared	Nest exposed to direct sun	Deserted by parents
60*	1	1	8–10 "	"	"	Faulty nest (re-inforced)	"
2	1	1	18 "	"	Yg. dead in nest	Nest environs disturbed	"
78	2	3	3 "	good?	Yg. disappeared	"	"
104	2	0	18 "	"	"	"	"
97	4	0	3 "	"	"	"	"
65*	1	0	10 "	"	"		"
111*	2	0	21 "	fair, poor	"	shooting in colony	"
98*	2	0	18 "	good?	"	"	"
102	1	0	18 "	"	"	"	"
105*	2	0	16 "	fair	"	"	"
110	3	0	10 "	good?	"	"	"
109	2	1	2 "	"	"	"	"
15*	2	0	32 "	"	Yg. half eaten in nest	Tethered to nest for 11 days	Predator (parents?)
89	5	0	6 "	"	Yg. disappeared	A low nest	Predator (terrestrial?)
100	5	0	2 "	"	"	"	"
14	5	0	4 "	"	"	"	"
101	2	0	15 "	"	"	"	Predator (human?)

* One or more young lost previous to final destruction of brood—see table 3.

laid. Of 56 nests subjected to consistent egg-robbing experiments, 32 advanced into the incubation stage despite the reduced nest contents, the birds having laid 3 to 6, or an average of 4.35 eggs (table 1). In 14 of these nests from which eggs were removed daily

except for the first day, the number of eggs laid averaged 4.5. Nest robbing may possibly have stimulated further laying in two nests, Nos. 11 and 67 where 6 eggs were produced. In nests Nos. 32, 77, 78, 91 and 94 where as many as 5 eggs were experimentally added during laying a normal clutch of 4 or 5 eggs was laid despite the resultant crowding.

Twenty-four eggs collected on the day of laying or the following day failed to show any development in an incubator after being stored for 6 to 7 days in a standard egg-storage room at 55 degrees F. Another batch of 72 eggs kept for 1 to 4 days in the storage room and then packed and shipped for about 4 days more in insulated boxes, similarly failed to develop when set in an incubator. Of 13 eggs returned to nests for incubation after 4 to 6 days in the egg room, 3 were viable. Of 29 eggs returned to incubating crows after 9 to 23 days of storage only one was viable. The embryo in this egg, placed in an incubated nest on the 11th day, developed to about the 72 hour stage but adhered to the egg membranes.

Incubation and hatching.—As judged by egg warmth tested on the observer's face at each visit, incubation generally started with the laying of the last egg. Forty-six percent of the nests so tested had warm eggs when visited on the next to last day of laying; 78 percent had warm eggs on the day of laying the last egg, and 91 percent had warm eggs when visited during the first 5 days of incubation. Egg warmth was probably a fair indicator of a sitting bird for in several tests, made on moderately warm days, eggs had cooled markedly fifteen minutes after the incubating bird was flushed.

The incubation period, as calculated from the laying of the last egg to the first hatching, was 16 days in three nests, 17 days in eight nests, and 18 days in one nest. Nestlings were brooded an additional 9 to 14 days. Birds incubating sterile eggs sat as long as 21, 22, 24, 26, 26, 28 and 32 days before abandoning them. One bird, after seven days of sitting, fed and raised a nestling which hatched from an introduced egg.

Fourteen eggs disappeared from eight nests during incubation; six of these, however, were in three artificially supplemented and hence overcrowded nests. Slightly cracked eggs were tolerated in two nests for 3 and 4 days respectively, then removed, apparently by the parents. Three nests with broken eggs were abandoned. Of 77 undisturbed eggs which completed incubation in 22 nests, 68 (88%) hatched. Depressions in the shell near the "pipping line" in two unhatched eggs in two nests suggested abortive attempts at assistance from parent birds. Shells disappeared from nests within a few hours of hatching. Unhatched eggs remained in nests for 10 to 18 days after the hatching of nestlings, disappearing soonest in crowded nests. The invariable absence of shells or other remains

beneath the nests pointed to a removal of these eggs by the parents rather than by the growing nestlings.

The interval between hatching of the first and last young was generally three days in 4- and 5-egg sets. It was four days in one 4-egg set and one 5-egg set, and five days in one 4-egg (2 hatched) set.

Nestlings.—Young on the day of hatching weighed from 10 to 13 grams and averaged 12.3 grams. The weight increased about 3.4 grams the first day, and about 10 grams per day from the 2nd to the 7th day; it accelerated to about 18 grams per day after the 7th day to reach 250 grams or 20 times the hatching weight on the 18th day. Growth then retarded to roughly three grams per day until fledging on about the 35th day (fig. 3). The period of rapid growth between the 8th and 18th days coincided with the opening of the eyes. The retardation in growth after the 18th day coincided with the acquisition of clear bright eyes and a crouching (fear) reaction. The escape reaction was detected in two birds on the 25th day but did not become definite until the 28th day. Young birds reaching this age were either tethered to the nest or removed for other studies, but it is estimated on the basis of behavior that departure from the nest would not normally occur before the 32nd day and probably not until the 35th.

Pin feathers appeared on about the tenth day and feather tips about five days later. By the 19th day the crown was well covered with feathers. The middle (5th to 7th) primaries, useful as indicators of age, protruded about one inch beyond their sheaths on the 21st day, two inches on the 25th day, three inches on the 29th day, four inches on the 33rd day, five inches on the 38th day, and six inches on the 44th day.

The yolk sac measured roughly 10 mm. by 8 mm. in a five-day nestling, 6 mm. by 3 mm. in a 10-day bird, and was not found in a 14-day individual.

Nestling survival.—Of 88 nestlings which hatched in 31 nests, only 20 in 13 nests survived to the 30th day, a nestling mortality of 77 percent. Activities of the observer were probably a minor factor in this heavy mortality. Eighteen nests containing 43 young were abandoned or emptied during the nestling stage (table 2); in 14 of these the young were apparently deserted or removed by the parents following a disturbance, in four the loss was attributed to predators.

Thirteen broods were reduced by the loss of one or more nestlings without (or before) being completely destroyed (table 3). Of the 25 young involved, 19 were thought to have succumbed to competition from larger and stronger nest-mates. In nine of these the victim was the smallest member of the brood, and in six a weight loss was noted several days before death.

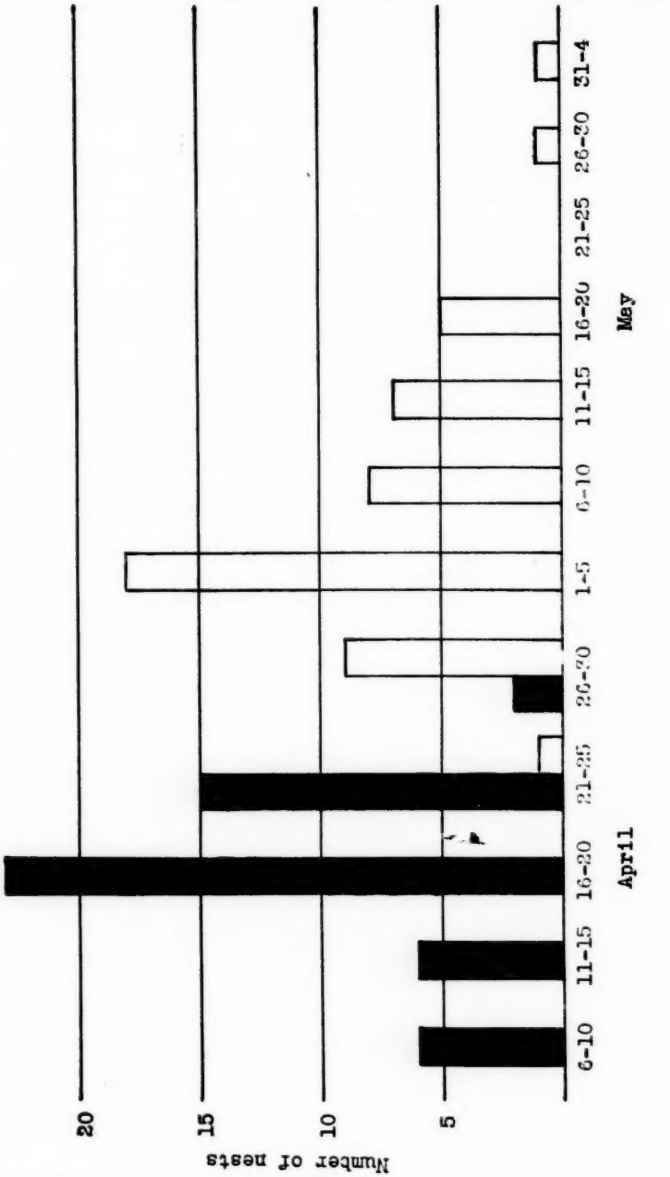

FIG. 2. Date of the first egg in 102 crow nests at Davis, California in 1942. Solid bars indicate first nestings; open bars indicate nests interpreted as renestings. Renesting was stimulated by extensive egg-robbing in first nests.

Only six nests were completely successful in that all the young which hatched were fledged. Five of these contained only one young bird, the sixth had three. This last was the only nest which held more than two nestlings after the 15th day; all other nests with 3, 4, or 5 young at hatching, were reduced during the first two weeks to one or two birds (table 3).

TABLE 3

FATE OF 25 NESTLINGS LOST IN 13 PARTIALLY DESTROYED BROODS

Nestling No.	*Nest Contents*		*Approx. Age at Death*	*Condition Before Death*	*Fate*	*Corollary Conditions*	*Presumed Cause*
	Yg.	*Eggs*					
15a	3	1	2 days	?	dead in nest	smallest of 3 yg.	neglected or crowded
68a	4	1	3 "	?	"	" " 4 "	"
b	3	1	10 "	poor	"	" " 3 "	"
111a	3	0	10 "	"	"	" " 3 "	"
103a	5	0	5 "	fair	"	" " 5 "	"
b, c, d	4	0	8–12 "	?	disappeared		"
105a	5	0	5 "	?	"		"
b, c	4	0	6–15 "	?	"		"
34Ba	3	1	5 "	?	"	" " 3 "	"
98a	3	0	8–15 "	?	"	" " 3 "	"
106a	4	1	4–8 "	?	"		"
b	3	0	15 "	poor	"	" " 3 "	"
39Bb	1	0	2 "	good?	"	had a 6-day-old nest mate	"
88a, b, c	5	0	3–5 "	poor?	"	poorly attended nest	"
d	2	0	31 "	poor	killed in fall from nest	frightened by observer	human interference
60a	2	1	4 "	"	disappeared	faulty nest	nest obstacle
108a, b, c	4	0	3–6 "	"	"	nest exposed to direct sun	heat injury
65a	2	0	4 "	good	dead in nest		?

SUMMARY

1. Observations were made on 111 crow nests in a walnut orchard near Davis, California.

2. A community roost was located within the colony.

3. Nests were generally well spaced, the closest being 80 feet apart.

4. Nest building required about 13 days for first nestings and about 9 days for renestings.

5. First sets were laid between April 6 and April 29; second sets, following removal of the first, were laid in the same nest after an interval of 10 to 12 days (five instances) or in a new nest.

6. The number of eggs in a clutch varied from 2 to 6 and averaged 4.4. Second sets were slightly larger than first sets.

7. Eggs weighed from 12.5 to 21.3 grams and averaged 16.6 grams. The first egg in a clutch was generally heavier than the last. Eggs in first and second nestings were equal in size Eggs in small sets were slightly heavier than those in large sets.

8. Eggs were generally laid at the rate of one per day.

9. Experimental removal or addition of eggs during laying had little or no effect on the duration of the laying period or the number of eggs laid.

10. Eggs held in storage at 55 degrees F. for 5 to 7 days, failed to develop when placed in an incubator; 4 of 42 stored eggs developed when returned to incubating crows.

11. The incubation period was 16 to 18 days. Birds sat on sterile eggs as long as 32 days.

12. Eighty-eight percent of undisturbed eggs hatched.

13. Nestlings averaged 12.3 grams at hatching, grew slowly at first, then rapidly, then slowly to reach approximately 300 grams at fledging on about the 35th day. The development of the fear reaction on about the 18th day coincided with the acquisition of clear bright eyes.

14. Nestling mortality was 77%. Greatest losses occurred through desertion of nests by parents and through competition between nestlings in crowded nests. Only one nest held more than two young after the 15th day.

A COMPARISON OF TWO CHICKADEE SEASONS

By EUGENE P. ODUM

BETWEEN September 1939 and September 1940 the Black-capped Chickadee (*Penthestes atricapillus*) population on the Edmund Niles Huyck Preserve was kept under continuous observation. An analysis of this annual cycle has been published (Odum, 1941a, b, 1942). Opportunity was provided for a study of at least a portion of a second breeding season when the writer returned to the area during June and July 1941. In 1940 nearly all the adults on the 375 land acres of the Preserve, a number in adjacent areas, and 31 nestlings were color-banded. In 1941 few new birds were banded but every effort was made to locate and study all birds, banded or unbanded, within the same study area and to locate banded birds

in buffer areas. In general, observations were conducted so that results would be comparable with those of the previous season. The following notes constitute a brief comparison of the 1940 and 1941 nesting seasons. The writer is indebted to Mrs. E. N. Huyck, the officers of the Preserve, and its Scientific Advisory Committee headed by Dr. W. J. Hamilton, Jr. for opportunity to conduct the observations.

Weather.—The following is a summary of mean temperature (°F). and total precipitation (inches) data for Albany, N. Y., the nearest weather station. Since the Preserve is about 1500 feet higher temperatures average four to five degrees lower and precipitation somewhat higher. However, the Albany data should suffice for gross direct comparison of the two seasons.

	Feb.	*Mar.*	*Apr.*	*May*	*June*	*July*
Mean Temperature—1940.....	21.8°	26.8°	41.7°	58.4°	65.0°	71.0°
1941.....	33.4°	27.9°	52.2°	59.3°	68.7°	73.4°
Total Precipitation—1940.....	2.83	4.53	3.93	3.68	2.83	4.23
1941.....	2.33	1.85	0.72	1.19	1.56	4.45

As can be seen the 1940 season was consistently colder and wetter, but by far the greatest difference occurred during April. This is important to note since in April the reproductive cycle begins to get underway. Temperatures were 5.1° below normal in April 1940 and 5.4° above normal in April 1941. March temperatures were 5–6° below normal both years. Except for March and April the 1941 season was near normal in temperature although somewhat below normal in precipitation. As will be noted below these differences in weather seem to be correlated with certain differences in chickadee behavior.

Population.—The total population on the Preserve was higher in 1941, being thirteen pairs or about 7.0 birds per hundred acres as compared to ten pairs or 5.4 birds per hundred acres in 1940. Excluding the 153 acres of early seral habitat which is not generally suitable for nesting or feeding activities in summer, the density figures are 11.8 and 9.1 birds per hundred acres of chickadee habitat, respectively. Single unbanded adults were also seen more frequently in 1941 (not counted in above figures); in 1940 there was almost no supply of unmated birds since birds which lost their mates had difficulty in replacing them (Odum, 1941b). The greater 1941 population together with success of more second broods (see below) is interesting in view of the marked invasion of Black-caps into the New York City and adjacent regions the following (1941) autumn (see Audubon Mag. "Season" reports). Wallace (1942) also reports an increase in chickadee population on the Pleasant Valley Sanctuary at Lenox, Massachusetts in 1941 following a progressive decline since 1937–38. Perhaps, therefore, the eruptive southward migra-

tion might be the result of a generally rising population level plus an early and successful nesting season. Certainly, most if not all of the chickadees reported from such unusual habitats as New Yokr skyscrapers during the autumn invasion must have been immature birds of the year, since they are normally given to wandering while adults seem to be relatively sedentary (granted, of course, that adults do not also become long-distance wanderers during periods of population pressure!). The net increase in population during the summer of 1940 was threefold. It was not possible to obtain comparable figures for 1941, but success was apparently even better. If such trends occurred over wide areas it is easy to see how the numbers of birds necessary for an invasion could be produced, although the problem of what causes the surplus to move into new areas (where many undoubtedly perish) still remains to be considered.

Although it is dangerous to generalize on the basis of small samples it seems safe to say that such eruptive movements are not to be correlated with any one factor, but rather with a fortuitous combination of factors both biological and environmental. To understand these movements, therefore, we need not only to know the life history of the species, but need quantitative data on populations (including trends) as well as weather and other environmental data during critical periods in the life history.

Returns.—Of eighteen color-banded adults known to be present at the end of the 1940 breeding season ten or about 56% were located in 1941. If it is assumed that birds not found perished, the year's mortality comes to 44%. It is quite possible, of course, that individuals might be missed since chickadees are relatively hard to locate during height of nesting. Also birds might have wandered too far from the area to be found. As evidence against the latter is the fact that all ten returns were located on or reasonably near their territories of the previous season, indicating that the adults return to (or remain on) the same general areas to nest even though they may wander more widely at other seasons or occupy a different area in winter. The return of males was better than that of females; seven out of eleven males were found but only three out of seven females. None of the 31 birds banded as nestlings could be found. As previously shown (Odum, 1941b) the young tend to separate from their parents and wander widely in late summer and autumn; apparently few may be expected to nest in the immediate area where hatched.

If Wallace's (1941) mortality figures for 1938 and 1939 are averaged with mine we get a chickadee mortality figure of 38% or roughly 40% and a theoretical average length of life of 2.5 years (reciprocal of 0.4). This yearly mortality figure is about the same as that computed by Nice (1937) for the Song Sparrow, a larger bird,

but is considerably lower than the mortality rate of the House Wren (Kendeigh, 1937) which is about 66%.

Pairings.—Of seven pairs in which both birds were known to be alive and banded at the end of the 1940 season, only one was the same in 1941. This pair occupied virtually the same territory as last year. One pair was missing entirely and in five pairs one bird was the same as last year but the other was a new, unbanded individual. In no case could the missing individuals be found; in other words no "divorces" could be demonstrated, the assumption being that the missing bird was dead or at least strayed far beyond its former haunts. The missing bird in four out of five cases was the female of the original pair.

With this additional evidence the question of permanence of mating in this species seems to be something as follows: Members of a pair remain together after nesting and may be expected to nest together the following season if both survive (or remain in same locality). Bonds between them, however, are quite loose, if existent, during the fall and winter flocking periods; at least I was not able to identify pairs by behavior during these seasons. Because of the relatively high rate of mortality the chances that one or both birds will not survive to a second season are considerable. If we take 40% as the average yearly death rate, from two-fifths to four-fifths (depending on whether one or both members die) or an average of three-fifths of the pairs will be disrupted annually. If mortality increases to 50% an average of three-fourths of the pairs will not be same the next season. Actually, therefore, the number of repeating pairs is likely to be in the minority rather than the majority, as was the case in the present study (see also Butts, 1931).

Territory.—Observations on territory in 1941 largely confirmed those of 1940, although because of my late arrival territories could not be mapped as accurately. In contrast to 1940, however, there was one case where territories overlapped, at least during the late stages of nesting. This occurred at the north end of the Preserve where population was most dense. The two nests were only 150 yards apart, and when discovered both pairs were busily engaged in feeding nestlings. The two pairs generally moved in different directions but a good part of the feeding areas overlapped. On one occasion when the male of one pair came within 50 yards of the other nest, he was immediately challenged and driven away, otherwise no contacts between the pairs were observed. As pointed out in the previous paper (Odum, 1941a) the size and the vigor of defence of the territory decreases as nesting progresses. Probably, therefore, the territories of these two pairs were much more distinct at the beginning of nesting than towards the end when all energies of both sexes are used in the care of the nestlings.

The most spectacular territory battle which I have observed in the chickadee occurred on June 20. Male R-BY with a new mate (his third in two years) was located this year on an area adjoining his last 1940 territory; on June 18 the pair were feeding nearly full grown young. In the meantime a new pair entered the unoccupied area and started a late nesting about June 4. On June 20 R-BY and his mate wandered over into his old but now occupied land (the young were nowhere to be seen); immediately the new male, R-AR, attacked, and for the next forty minutes a running battle occurred for about 200 yards along the east boundary of the territory. I was attracted by the first outburst and was able to observe the entire proceedings at close range since birds were mostly down low and paid no attention to me. All the characteristic notes and behaviors were observed, but there was much more actual fighting than usual. R-BY was clearly the better fighter and on more or less neutral ground continually repulsed the other's repeated attacks. However, when the invader moved well into the territory the resident bird seemed to redouble his efforts and would succeed in driving the invader back each time, a very nice illustration of advantage held by the established owner of a territory. The females of both pairs were present but were generally content to remain a few feet back of the broad fighting zone and give vocal encouragement, while the males flew back and forth at each other. At least once, however, when male R-AR (the owner) was particularly hard pressed his mate dashed into the fray. At intervals she would return to the nest to incubate (nest was about 200 yards from scene of most of fighting), but at each fresh outburst she would come dashing out to the scene of battle. Finally, the invading pair drifted off toward the east leaving the owners in full possession.

Time of nesting.—Nesting was fully two weeks earlier in 1941. The average hatching date of six nests in 1941 was May 23 (determined by figuring back from time young left the nest) as compared to an average of June 5 for seven nests in 1940. Assuming an average incubation period of thirteen days and seven eggs per set, the average date of the laying of the first egg would be May 5 and May 18, respectively. This difference is apparently correlated with the difference in April temperatures since weather conditions during the other months were not greatly different (see above data). In 1940 the preliminaries to actual nesting (spring movements, breakup of flocks, pairing, etc.) were noticeably prolonged as flocks would alternately break up and reform at each April cold spell. In 1941 the warm weather of April undoubtedly speeded up these activities, enabling actual nesting to begin sooner. In an analysis of fourteen House Wren seasons Kendeigh (1937) found that time of the laying of first egg varied eighteen days and was inversely corre-

lated with temperature, particularly average night temperature. No statistical correlation was obtained with precipitation, relative humidity, wind velocity, or total possible hours of sunshine (p. 112).

Number of broods.—There was only one second brood completed in the area in 1940 as compared with at least three in 1941, probably correlated with the earlier season. This illustrates how progress of spring may influence the amount of reproduction since apparently a second brood is more likely to be attempted at this latitude when the first brood is completed fairly early in June.

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THE LIFE SPAN OF THE COMMON TERN (*Sterna hirundo*)

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THIS paper is based solely on work which has been done in a group of colonies of Common, Roseate and Arctic Terns which breed annually on Cape Cod, Massachusetts. This group's present composite population of about 30,000 individuals has remained practically stable for the last thirteen years. The banding of chicks in these terneries which was instituted in 1922 and trapping their adult members, first done in 1928, have been continued through the 1942 nesting season without interruption and with progressively increasing thoroughness. Personnel from the Austin Ornithological Research Station began work in these colonies in 1929 and since 1931 their study and conservation has been one of this station's major undertakings. Descriptions of these colonies as they have varied from time to time, their locations and histories as well as

[1] Contribution No. 37 by the Austin Ornithological Research Station.

some of the results of their investigation have been reported in a series of articles, first by Mr. Charles B. Floyd, more recently by ourselves, enumerated in the appended bibliography.

At the conclusion of the 1942 nesting there have been banded in this group 144,886 chicks. Although during the earlier twenties this marking of juveniles was done more or less superficially, since 1933, especially in the larger and more productive sites it has been as comprehensive as the welfare of these colonies has permitted, approximating 90 to 95 percent of the hatch. During the same interval a total of 56,986 adults, including returns, have been trapped and banded. As a rule, only one of the pair tenanting each nest has been caught each year, the capture being indicated by placing

TABLE NUMBER 1

WORK DONE IN THE CAPE COD COLONIES CONSISTING OF COMMON (*Sterna hirundo*), ROSEATE (*Sterna dougalli*) AND ARCTIC (*Sterna paradisaea*) TERNS

	BANDINGS						*RETURNS*	
	Adults		*Chicks*		*Total Adults and Chicks*			
Year	*Hirundo*	*All Species*	*Hirundo*	*All Species*	*Hirundo*	*All Species*	*Hirundo*	*All Species*
1922	0	0	94	151	94	151	....	....
1923	0	0	298	380	298	380	....	....
1924	0	0	1,000	1,689	1,000	1,689	....	....
1925	0	0	2,570	2,594	2,570	2,594	....	....
1926	0	0	4,057	4,830	4,057	4,830	....	....
1927	0	0	4,703	4,703	4,703	4,703	....	....
1928	164	164	4,131	5,331	4,295	5,495	5	5
1929	918	918	3,283	5,100	4,201	6,018	31	31
1930	248	248	2,789	3,344	3,037	3,592	16	16
1931	117	123	7,552	8,648	7,669	8,771	11	11
1932	1,231	1,239	6,588	7,834	7,819	9,073	80	80
1933	2,601	2,648	3,642	4,376	6,243	7,024	209	209
1934	4	4	12,398	15,820	12,402	15,824	7	7
1935	3,113	3,424	11,920	15,851	15,033	19,275	619	629
1936	4,991	5,435	6,210	8,781	11,201	14,216	1,891	1,990
1937	2,529	2,556	4,845	6,552	7,374	9,108	1,996	2,005
1938	4,378	4,798	6,654	9,322	11,032	14,120	2,656	2,694
1939	3,559	3,855	10,244	11,441	13,803	15,296	3,214	3,242
1940	3,446	3,885	8,846	10,903	12,292	14,788	3,098	3,177
1941	3,433	3,811	8,858	10,981	12,291	14,792	3,243	3,314
1942	2,482	2,660	3,999	6,255	6,481	8,915	3,786	3,838
Total	33,214	35,768	114,681	144,886	147,895	180,655	20,847	21,248

a wooden marker at the nest, but retrapping nests a second and even a third time during the season has resulted many times in taking the mates of individuals already caught, thus improving the sampling in case either sex preponderates in the incubation. It further accomplishes the inclusion of birds which nest later than the average, also those renesting after frustration. The annual adult take for the last five years has been about one-fourth of the estimated population. Of course the percentage of their constituents caught varies in the several rookeries, for trapping is always many times more successful in an old and large colony where behaviour is more consistently concerted and the birds are less wild. The capture of

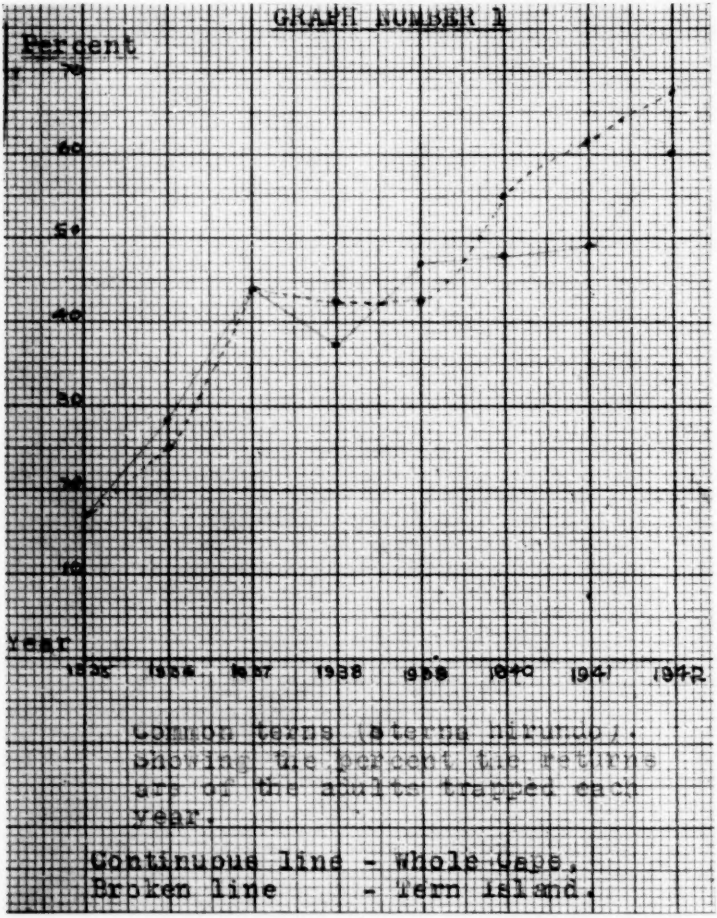
birds banded preceding years, so-called returns, total 21,218. Many individuals—657 in 1942—are taken twice or more yearly. Although our work has been carried on more intensively in two or three of the larger colonies by reason of the greater stability of their individual content over a period of years, all known colonies of as few as ten individuals have been trapped routinely.

The records of this field work have been inscribed carefully in the station's records in a variety of ways, statistically arranged, graphed and analyzed. Every tern taken subsequent to its original banding as a chick or capture as an adult has an individual card—these being arranged serially—on which are noted the time and place of its first handling, its age at that time, followed by similar details of all its succeeding takings, also the date and cause of its death when known. Since only personnel from this station have done work in the Cape colonies since 1930 omission of pertinent details are obviated. From time to time it has been found necessary to change the status previously assigned some individual birds and make small corrections in published totals.

These data, as has been pointed out (Austin, 1940) delineate a picture of a distinct, concrete group of tern colonies which is self-sustaining, its membership consisting almost absolutely of its own progeny. This offspring has been banded regularly for a decade and a half covering a span of years greater than their value to the group as breeding components. The inevitable result of such systematic work has been a consistent increase in the percentage of banded birds in the yearly take of adults. This is shown on graph no. 1. From 6 percent in 1932 it has risen to 57.9 percent in 1942. Allowing for the impracticability of banding the entire hatch and capturing more than one-third of the adults present each year, this percentage is close to a theoretical maximum. The Tern Island colony, which is the largest in the group and the one in which the component individuals are most consistently those of preceding years, has been worked more thoroughly than have the others. As is shown on graph no. 1, the annual percentage of returns from there is higher than it is for the group as a whole, likewise the yearly rate of increase in this percentage is greater. The curve thus delineated more nearly approximates the maximum it is feasible to obtain and is a reasonably adequate basis for drawing credible conclusions. Since the capture of banded adults is the *sine qua non* in any population or survival study of a species, the returns we have obtained constitute the central figure in the picture.

Since the exact age of an individual bird can be determined only by the band it wears, it is unfortunate that those placed on terns last, as a rule, only about ten years. This is varied in both directions by some unknown environmental activities experienced, for one

band, still fairly legible, and seventeen years old was found on a tern this summer. Some series, notably the 34-300,000, have disintegrated more rapidly than others. Since all the bands carrying



GRAPH NO. 1

Common terns (*Sterna hirundo*). Showing the percent the returns are of the adults trapped each year.

numbers anteceding 500,000 we have recovered on trapped adults are so very much eroded and their ends so far apart that gentle handling frees them from the birds' tarsi it is probable there are surviving in the colonies some individuals which have lost bands affixed to them in the earlier years. We have obviated partially this detriment to exactness by routinely placing a second new band on the other leg of all adults wearing bands either well worn or over nine years old. The demonstrated tenacity with which individual terns occupy a precise spot in a ternery year after year and their repeated capture there suggests to experienced workers the possible age of such individuals but this, of course, must not be utilized for any accurate scientific determination. It must be realized that in the Cape group are a goodly number of adults whose ages are not known, this being the result either of their having lost their bands or of having missed being trapped.

The epoch of years covered by the work with this group of terns

TABLE NUMBER 2

RETURNS

Year	*Hirundo* *Banded as Chicks*	*Banded as Adults*	*Total*	*All Species*
1928	5	0	5	5
1929	28	3	31	31
1930	10	6	16	16
1931	6	5	11	11
1932	38	42	80	80
1933	78	131	209	209
1934	0	7	7	7
1935	174	445	619	629
1936	310	1,581	1,891	1,990
1937	361	1,635	1,996	2,005
1938	639	2,017	2,656	2,694
1939	723	2,491	3,214	3,242
1940	706	2,392	3,098	3,177
1941	581	2,662	3,243	3,314
1942	....	....	3,786	3,838
Total	3,659	13,417	20,862	21,248

is sufficiently long and the sampling of the colonies is quite large enough as well as comprehensively representative to eliminate errors which would result if these factors were of shorter duration and less voluminous. Season abnormal mortalities, accretions and emigration from one site to another, balance each other and tend to cancel out during the time covered. The yearly variations in chick yield and survival is similarly leveled to a consistent figure for the period as a whole. If the figures for a single year or two are tabulated, comparison with other similar compilations shows not inconsiderable divergences; if they are graphed, sharp breaks appear in the curves. But every additional year's numbers included smooths off these irregularities more and more completely. This, confirmed by other evidence secured, demonstrates that seasonal variations are of small moment in the long run, that the causes of

mortalities and the adjuvants to conservation equalize each other, if not in any given year, assuredly they do in the aggregate of a number of seasons.

In 1930, by statistical methods of analysis, conclusions were deduced from a meagre 781 adults trapped in a single rookery of which only 29 were returns (O. L. Austin, Jr.). The very large amount of data acquired since then has shown that these inferences were substantially correct. So it is justifiable to believe that by a simple analysis of the enormous totals already given it is possible to determine the life span of the Common Tern, to show what part the composite individual plays during any given year or total of years in the status of a group of colonies, even to infer from these findings that this Cape Cod group's future may be foretold as satisfactory. This last is predicated also on what we have learned to be this species' reaction to occurrences and environmental changes which could affect its welfare.

It is solely a matter of passing interest to know the extreme ages attained by terns; one known to be sixteen years old probably corresponds to a human centenarian. It is of scientific value to know the period of years they are able to carry on an efficient response to their primary and most compelling motivation to perpetuate their species, not alone as individuals but as breeding colonies or similar aggregations. By this is meant an ability to maintain their population level and to raise it if this must be done to compete successfully with other species in ecological contact with themselves. We are led to believe this purpose has been accomplished during the last decade not alone by counts and estimates made in our field work but by correlating three other credible findings. The first is the number of individuals of a year's hatch found in the colonies each year of their lives, this being the average for a number of years rather than for any single one; second is the probable death rate for terns at each year of age; third is their total life span.

We have no evidence that the Common Tern is highly specialized in such important attributes as food requirements, territorial requirements and even in their behaviour as a whole, consequently there can be no shrinkage in their population total such as occurs in species whose essential needs are so limited that they are unable to substitute for the deprivations which always occur. A species which has made so great a numerical comeback after the devastations of plumage hunting, evictions from nesting sites and thwartings of many and varied sorts must have an inherent ability to make readjustments to the necessities of altered environment. Although the span of twenty years covered by work done in the Cape Cod tern colonies is but a small fraction of the time thought to be necessary for recognizable evolutionary or degenerative changes to come

to pass in a species, it appears to have been sufficient for the development of a trend toward increased productivity. It seems to have been much greater than what has been accomplished by efficient conservation measures during the last ten years. There have been no evidences of a drift toward increased specialization such as the laying of smaller clutches, obstinate tenacity of deteriorating nesting sites and emigration because there has been a great and growing shortage of their preferred food, the sand eel.

TABLE NUMBER 3

BANDED AS CHICKS

Years Old

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*Total*
Taken in 1938...	3	20	183	257	47	23	48	11	28	7	7	4	0	1	...	....	639
1939...	9	27	132	198	201	57	23	33	10	18	5	3	6	1	...	....	723
1940...	22	30	51	184	173	148	36	12	17	3	14	7	3	5	1	....	706
1941...	10	22	51	49	145	106	119	27	7	17	4	10	3	4	5	2	581
Total ..	44	99	417	688	566	334	226	83	62	45	30	24	12	11	6	2	2,649
Percent	1.7	3.7	15.7	25.9	21.3	12.6	8.5	3.1	2.4	1.7	1.1	0.9	0.5	0.4	0.2	0.08	

BANDED AS ADULTS

Years Since Banding

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*Total*
Taken in 1938...	561	791	420	16	144	58	7	9	10	1	3	1	....	....	...	....	2,021
1939...	854	452	666	350	8	97	42	4	5	6	....	....	....	....	...	....	2,484
1940...	787	564	295	436	214	4	57	28	5	3	6	....	....	....	1	....	2,400
1941...	759	656	436	252	316	156	8	52	19	2	2	4	....	....	...	....	2,662
Total ..	2,961	2,463	1,817	1,054	682	315	114	93	39	12	11	5	....	....	1	....	9,567
Total of Both...	3,005	2,562	2,234	1,742	1,048	649	340	176	101	57	41	29	12	11	7	2	12,216

Insomuch as the factual material used in this paper has been obtained in the single collection of tern colonies comprising the Cape Cod group recently described (Austin, 1940), it may be questioned whether the conclusions herein expressed are applicable to Common Terns as a whole. This is unwarranted, first by reason of the complete absence of evidence to the contrary. Further, variations in behaviour from that of the Cape Cod group, narrated as having been observed elsewhere, are duplicated by divergences in the several colonies which make up the Cape Cod group itself. These are simply inevitable adjustments to dissimilar environmental conditions and they do not impair reproductive accomplishment over a period of a few years. The procreative instinct is so primal and compelling that it functions for terns as a whole exactly as do

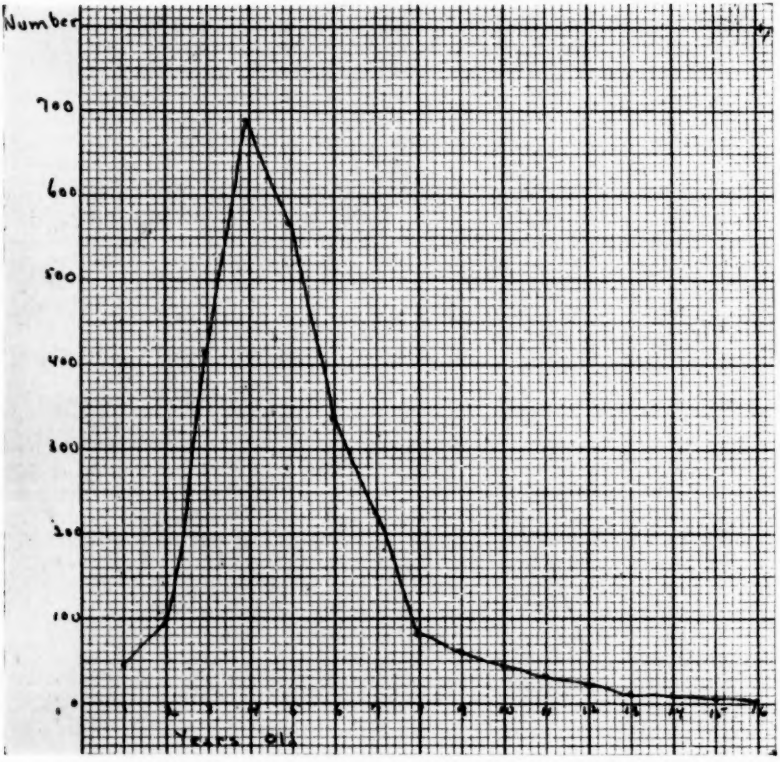
the physiological processes which transmit plumage characteristics. Accordingly it does not vary in potency and accomplishment in the species as a whole regardless of what variations in environment component groups experience during a nesting season.

In the biological order of things it is of no moment how long the members of a species live provided the span allotted them to reach and maintain sexual maturity is long enough for a generation to duplicate the achievement of its predecessor. The longer this span the less the tendency toward specialization although an unduly long period of productive efficiency might result in a numerical increase so great the species' adaptability would necessarily deteriorate. That the life span of the Common Tern is now of a desirable length may be assumed from the fact that for more than a decade this species appears to have maintained a fixed numerical level. This applies at least to the Cape Cod group, the largest known in North America, sufficiently numerous to obviate under all probable handicaps and mishaps what inevitably happens to a species which has been reduced in numbers to an unsafe maximum. This is not jeopardized but rather it is enhanced by the peculiar manner in which Common Terns are found to be segregated into groups which do not exchange memberships to any practical extent, for a major disaster occurring in any single group is solely a local affair and can have no effect, for at least a decade, on the normal replacement in other groups. Seasonal failure to yield the customary number of chicks can occur in a colony for at least three consecutive years without reducing its population sufficiently to disrupt and disperse it; almost always there is a subsequent year or two of at least average success, either on the original or a new nesting site. It is not necessary for either a single colony or a group of them to keep the population total uniform from season to season provided there is no consistent trend toward reduction. Our findings have been that the life span is sufficiently long to afford ample opportunities for a generation to balance its failures and successes.

The Cape's largest colony has nested at Tern Island, Chatham for the last twenty years. Its population has varied from time to time between ten and twenty thousands; its chick yield under normal ecological conditions is always abundant. In 1932 and 1933 by reason of predation, it matured only a fraction of its usual number, yet the following year it raised almost twice as many young as it had before or has since. Every year one or more of the colonies which make up the Cape group fail more or less completely, yet the number of birds comprising the group as a whole remains almost stationary. This, however, is somewhat contingent on the plethora of new-born that Nature always provides in the scheme for perpetuating a virile species. We have found that when one of our fairly large colonies

has been deprived of its nesting site by the elements or other destructive forces, the following season it appears nesting as a fairly complete unit in one of the other rookeries. This was done in 1941 by the several thousand birds which in 1940 had accomplished a successful nesting on North Point. But when, as is of more common occurrence, there is a gradual reduction over a few years of available nesting territory in a ternery by reason of continued erosion or progressively increasing overvegetation, the evicted birds amalgamate with the other colonies according to a predictable pattern based on their ancestry and the ecological desirability of available sites. This happened to the Egg Island colony in Lewis Bay, in 1932 a prolific aggregation of 5,000 birds, reduced by 1940 to a dozen pairs; the Billingsgate colony has dispersed similarly. The adult trapping of foster colonies during the years of such realignments by which this has been shown, has demonstrated also that the disappearance or death rates for former members of these defunct colonies is only a small percent greater than they are for normally functioning components of the Cape group. Since all Common Terns, in so important a matter as reproduction must function alike, it is believed that adult trapping would have shown that this is what had happened to colonies believed to have been destroyed in other sections of the species' breeding range. It is highly probable that less propitious terminations of these and similar occurrences would have affected adversely the maintenance of the population level and since it has required a period of from two to six years to avert their taking place, direct evidence is afforded of the adequate length of the life span.

To facilitate comprehension, some portions of our data have been segregated and presented in tables and graphs. There is a table (no. 1) showing the distribution by years of the chick and adult bandings and the returns for the group as a whole. Recoveries of Cape banded terns elsewhere have been reserved for another study. Since only returned adults which were banded the year of hatching afford accurate material for a study which concerns their age, a table (no. 2) is included showing the number of chick banded adults which have been taken each year. In view of what has been stated before, it is believed correctness will be increased by limiting our consideration largely to such returns as have been taken in the four most recent years available at this moment, 1938 through 1941. (Table no. 3.) This will allow the inclusion of a higher percentage of birds known to be from three to eight years old, the epoch of their lives, as will be shown, when they are of numerical importance in the maintenance of a population level. The total returns for these four years is 12,211 of which 2,649 or 21.7 percent were banded as chicks. A graph (no. 2) has been made of these chick-banded birds



GRAPH NO. 2

Common terns (*Sterna hirundo*). 2,649 returns taken in 4 years, banded as chicks, showing age when taken as returns.

Taken in 1938	639
Taken in 1939	723
Taken in 1940	706
Taken in 1941	581
	2,649

based on their age at the time of their capture during this interval. As a suggestive corollary, a graph (no. 3) shows the duration of life attained by birds banded while adults which were taken during this quadrennial. Greatest accuracy is attained in graph no. 4 which

depicts the percentage the chick-banded birds are at each year of their age of the total number of chicks banded during the four years preceding the first year of age reached.

Taking into consideration only the greater of the known variables it is surprising how small the deviations are in graphs 2 and 4 from the line of a true curve, also that there is not greater disparity between the yearly points in the two. There are large differences, from year to year, in the number of chicks hatched, the percentages of the hatch which are banded and the ratios of survival, not only in the individual colonies but in the group as a whole. There are annual disparities in the fractions of the adult populations trapped. Some seasons, excessive predations have raised the death rate of adults above the normal. In spite of their thoroughness the samplings do not duplicate each other yearly. Since deviations which result from these and other causes are not more marked for the four year period which is more than one-third of that part of the terns' life span, it is probable that even these divergences would be ironed out by duplicating data which covered a dull decade.

The greatest ages attained by Common Terns is shown in the following table:

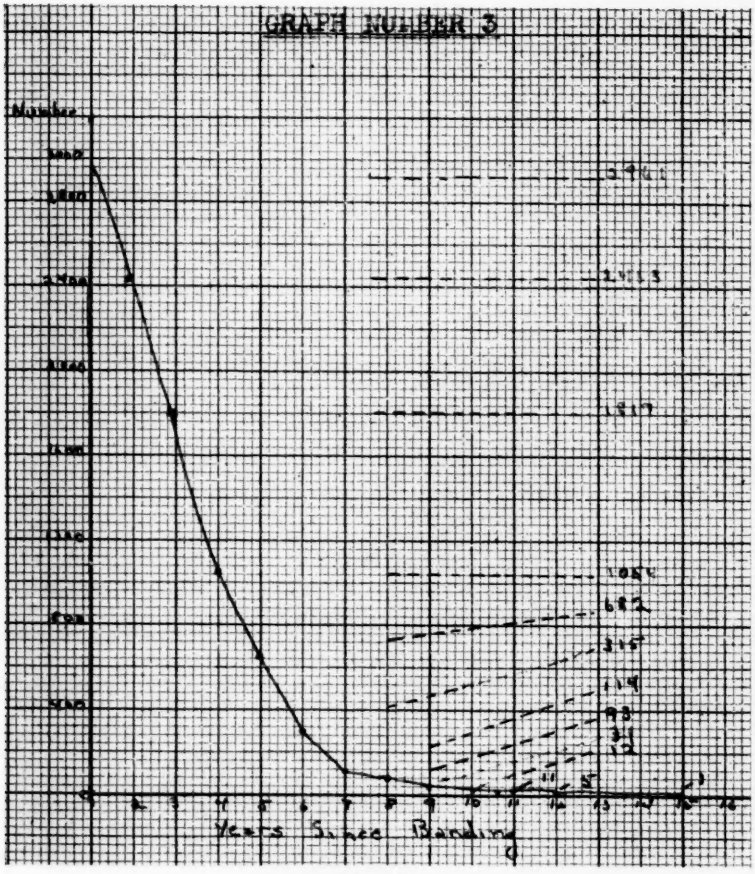
Years old	14	15	16
Taken in 1938	1	..	..
1939	1	..	..
1940	5	1	..
1941	4	5	2
Total for 4 years	11	6	2

In 1940 one bird banded as an adult fifteen years before was caught, so, when retaken, it must have been at least sixteen years of age. It cannot be gainsaid that this individual was not even older for the graph shows that only forty-four or 1.6 percent of all the returns taken in the four years bred their first year. This season, 1942, a Common Tern seventeen years old was trapped at Tern Island. Accordingly, at the time of this writing, seventeen years must be considered the extreme of a Common Tern's life expectancy. But since each of the last three seasons a year has been added to the then known limit, seventeen years must not be adjudged the absolute ultimate. The Marples have postulated the presence in one of their colonies of an older bird but with no credible supporting evidence. The only concrete evidence of the advanced age of birds is based upon recapture of adults which were banded as chicks; there is no other way of even surmising that terns have reached advanced ages. It must be stated in retraction of previous suggestions (Austin, 1938) that two years of careful observation have convinced us that, in behaviour, very old birds differ from their younger associates only in the matter of tenacity to former nesting

sites; also that there are neither plumage changes nor variation in the coloration of soft parts incident to or characteristic of their senility. Since unusual longevity is possible for any bird, these very old breeders must be considered simply interesting but unimportant anomalies with one reservation—their consistent return to their former tenures is a factor in maintaining flock adherence which, in the long run, enhances reproduction.

It is axiomatic that the number or percentage of a season's banded hatch found breeding subsequent years indicates two things: first, the degree to which the urge and ability to procreate functions during the several years of their lives; second, their value, according to their ages, to the primary purpose of a nesting. Since there is much evidence indicating that, once achieved, the ability to procreate continues until death, the first applies to the first few years and until the maximum of the hatch have become consistent breeders. This peak is reached in their fourth year. The second indication bears especially on the remainder of their lives, for after full maturity has been achieved the death rate rises with progressively increasing rapidity as age advances. Observations made during the last few years indicate, in contradiction of formerly expressed opinions, that neither juveniles with undeveloped gonads nor sexually defunct birds hold membership in breeding colonies. Such were supposed to form a part of the flocks of birds seen along the shore-lines of terneries. Now it is thought that early in the season these assemblages consist almost entirely of breeding members of the colony without clutches to incubate. Later in the summer they comprise birds migrated to the site for renesting and others which, having either raised their young or become otherwise impotent, respond to a well developed social tendency. At all times they contain nesting members of the colony.

The life of a Common Tern, in spite of variance by a negligible percentage of individuals, appears to be divided consistently, and, from a practical standpoint, rather definitely into three epochs which may be designated youth, maturity and destruction. The word youth is used rather than adolesence because sexual activity does occur during this period and the term implies a behaviour pattern not so propitiously developed and fixed as it is in fully developed birds. By rights, this should be subdivided into there parts demarcated by radical differences in the degree of physical development, changes in environment and mortality. Maturity has been selected for its appropriateness without intimating its literal definition. Destruction has been chosen rather than senility because all available evidence indicates that in this species the procreative instinct, potency and fecundity persist without waning until death. In view of this, if physiology alone is made the basis



GRAPH NO. 3

9,567 returns taken in four years banded as adults showing years of survival after banding.

Taken in 1938	2,021
Taken in 1939	2,484
Taken in 1940	2,400
Taken in 1941	2,662
	9,567

for partitioning a tern's life, these last two epochs should be combined into one. On the other hand, as shown by graphs 2 and 4, there is so sharp and angular a leveling off of the curve at the suggested dividing line between maturity and destruction that a definite change in the status of terns of this age as a whole is indicated. The abrupt cessation at this point of the rapid annual decrease in numbers breeding suggests that those surviving are no longer an important factor in the colony's prosperity.

Youth embraces the first two years of life and ends at the beginning of the third summer when, as the graph shows, more than one half of those of a hatch which are still alive have begun annual procreation. That a great change in both the physiological and psychological functionings has taken place abruptly is indicated not only by the numbers involved but also by the development of concerted action in flock formation and the adoption of flock behaviour. The first subdivision terminates when the young leave the terneries; the next covers the remainder of the first year; the last in the second year. As is conventional for most living things, the period as a whole is one characterized from its beginning by an enormous mortality which gradually drops to safer levels in accord with the progressive acquisition of physical plenitude and protective adaptability. It is that portion of a tern's life when ancestry and inheritance appear to count most, as is shown not only by the greater chance for survival a grey plumage-phased chick has in comparison with one of brown coloration, but also by the observation that a much larger proportion of the offspring of some colonies commonly reach the epoch of maturity than do those of others.

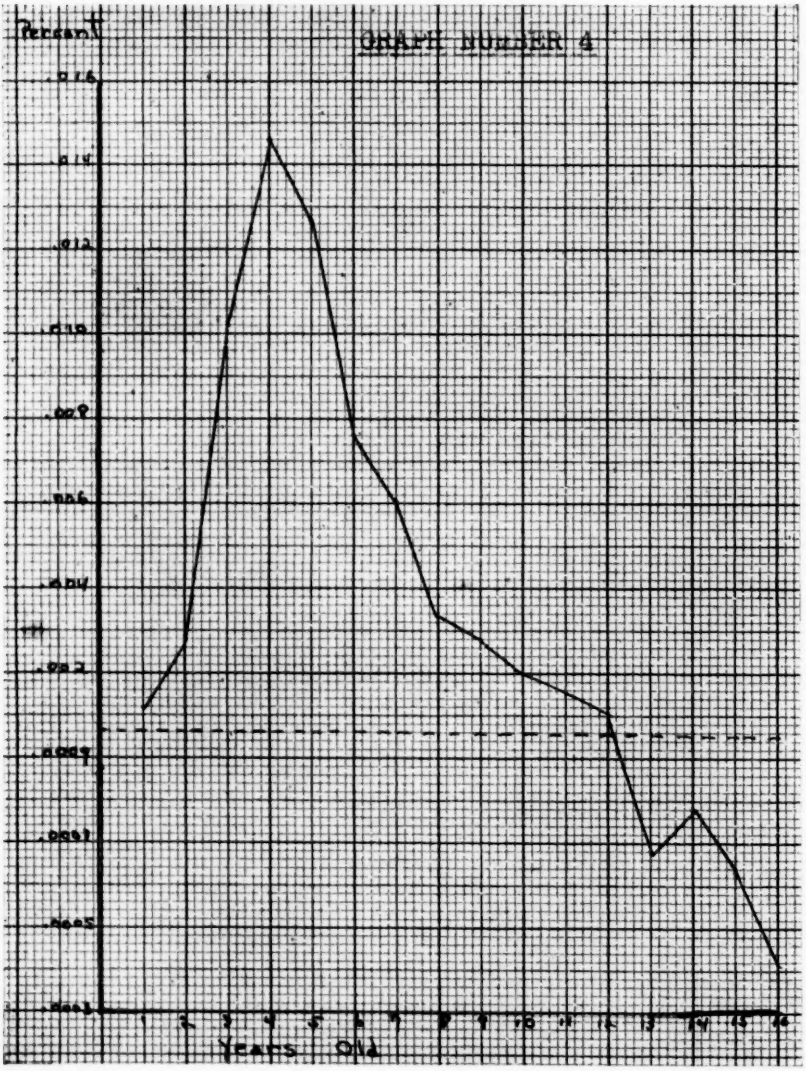
The first subdivision of the period of youth is the most precarious for it is during these few weeks that death takes its greatest toll. The inevitable minimum, which is large under the most favorable conditions, is increased exceedingly by the incidence of such deleterious occurrences as severe storms, predation and parental neglect. Of course there is a prompt decrease so soon as chicks have learned to fly. In 1939, a highly successful year at Tern Island, superfically incident to other work we buried dead chicks totalling 21.5 percent of the hatch. It is believed that of the entire hatch in a large colony which has had a season of average success, seldom more than two-thirds and often much less survive to leave the vicinity of the site. There is also another important but intangible cause of chick mortality concerning which we are not orientated. In the Cape group there is a colony at Jeremys Point with a population which fluctuates seasonally between 200 and 2,000, often augmented at midseason by renesting birds which have been frustrated elsewhere. On this site the normal number of average sized clutches are laid and hatched but invariably the chicks die within one or two days or

simply disappear. It is rare for one of this colony's young to live to flying age. Every season we have found the same thing occurring elsewhere on the Cape but not consistently in any one colony. This year it has taken place in a generalized way in all the terneries but to a much smaller degree. The result has been that in spite of almost unprecedented freedom from predation, meteorological inclemencies and other detrimental incidents, the chick survival has been the smallest in nine years. Further, the Tern Island colony, in 1934 and 1935, no larger in those years than it has been this summer, produced more than twice the number of young it has this nesting. It is comprehensible that this has occurred to a considerable sector of this group of terns simply by the more common functioning of its unknown cause. Obviously an affair of this sort must be the result of something inherent in the chicks themselves, if not disease perhaps some temporary digression from their usual physical inheritance.

There is evidence that a large number of chicks perish during the remainder of their first year. From late July until the end of October a considerable number of the banded young of the year are picked up dead or moribund widely over the Cape and the adjacent mainland, also along the shore line to the south and inland in nearby states. Later in the winter, the mortality remains high by reason of an insufficiently developed protective reaction to the vicissitudes of an unfamiliar environment. This is suggested by the fact that of all the recoveries made on the wintering grounds, eighty percent at least are birds of the year.

Very little is known of the whereabouts and status of terns during the second and last year of youth, although it is known that some of them have remained on the wintering grounds. The number nesting this particular summer is only double that of the few which do so the first after the one of hatching, whereas it is multiplied sevenfold the one which follows.

The epoch of maturity embraces a span of six years beginning with the third one in a tern's life—collectively speaking—reaching its numerical peak in the fourth and ending with the eighth. If the demarcations we are making were based solely on the number of birds found breeding each year of their lives, graph no. 2 would fix the seventh year as the credible termination, since the total of those taken in their eighth summer is less than it is in the second year of youth. If the criterion is the percentage of banded chicks which do return the several years of their lives, graph no. 4 necessitates adding the eighth year to this era. This because of equal importance with numbers is the sharp angulation in the line of the graph to a new and continuous degree of curvature with a new average for the sizes of the abscissae. Obviously, this is the portion of the



GRAPH NO. 4

Common terns (*Sterna hirundo*). 2,649 returns banded in four years as chicks. Graph shows the percentage the returns at each age are of the total number of chicks banded the four years preceding the first year of each age reached.

life span of the Common Tern which is essential to the maintenance of the population total. Under ordinarily favorable ecological conditions, the remaining part could be eliminated without causing jeopardy for, as table Number 3 shows, of the 2,649 chick-banded adults taken in four years 2,334 or 87.1 percent were between three and eight years of age. Adjuvating this great numerical preponderance, is a well developed, propitious and fixed behaviour pattern which exhibits very little of the vagaries of youth and a minimum of the fixed and deleterious habits of senility. Most of the changes which take place in its outlines are for the better since they represent a reaction to experience by individuals at the height of their virility. Of additional value and in marked contrast to the sudden transition from youth into maturity which results from the abrupt onset of gonadal functioning is the slower decline subsequent to the fourth year peak. This is due not to causes intrinsic in the birds themselves but rather to influences originating in environment.

The final epoch is simply the progressive extinction of those remaining individuals which either possess inherent constitutional superiority or greater adaptability, or else have unusual good fortune.

On graph no. 2, in contrast to the almost vertical line for the middle period, is one almost horizontal yet with a consistently downward trend to the sixteenth year when extinction is almost complete. This trend, while much less visually patent in graph no. 4 is emphasized by all the points subsequent to the twelfth year being below the line horizontal to the point for the first year. The status of behaviour and the procreative ability during this era have been suggested in preceding graphs but it is of interest that in the single instance in which we trapped the mate of a bird twelve years old, both banded as chicks, the second was six years younger.

We entertain no delusion that what has been written is conclusive and final. It simply offers our interpretation of the data available at the moment. Either our work embraces too short a period of time or the determining facts have not been obtained for, from a purely theoretical standpoint, especially if the reasoning is done in reverse, the Common Tern may well have a life span of twenty or more years.

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RETURNS FROM BANDED BIRDS: SOME LONGEVITY RECORDS OF WILD BIRDS

BY MAY THACHER COOKE

(*Continued from page 119*)

TOWHEE. *Pipilo erythrophthalmus*

*B223710, banded at Demarest, N. J., on August 8, 1933, by Keahon Garland, was retrapped at same place June 25, 1937, rebanded with B223755, and again retrapped May 12, 1938.

B237662, banded at Summerville, S. C., on April 10, 1933, by W. P. Wharton, was retrapped at same place January 31, 1937.

*C126037, banded at Demarest, N. J., on August 3, 1932, by B. S. Bowdish, was

retrapped at same place May 9, 1935, rebanded with 34-247690, and again retrapped June 1, 1938.

*34-235642, banded at Lexington, Mass., on July 27, 1934, by Mrs. Ada C. Govan, was retrapped May 20, 1935, and July 12, 1939 at same place.

35-117841, banded at Huntington, L. I., N. Y., on June 27, 1935, by Geoffrey Gill, retrapped at same place July 18, 1936, July 12, 1937, October 6, 1938, and May 16, 1939, was rebanded August 4, 1939, with band 39-122343, was retrapped May 11, 1940.

35-213572, banded at Nashville, Tenn., on November 13, 1935, by Mrs. F. C. Laskey, was retrapped at same place July 11, 1939, and April 7, 1940.

SPOTTED TOWHEE. *Pipilo maculatus*

*A237627, banded at Berkeley, Calif., on July 23, 1931, by E. L. Sumner, was found dead at same place September 11, 1936.

A265873, banded at Garnet Valley, Summerland, B. C., by S. A. Liddell on July 5, 1932, was retrapped at same place March 13, 1937, rebanded with 34-227082, and again retrapped March 28, 1938, June 12, 1939, and March 19, 1940.

BROWN TOWHEE. *Pipilo fuscus*

*A274362, banded at Strawberry Canyon, near Berkeley, Calif., on July 25, 1932, by E. L. Sumner, was killed in mouse trap at same place November 3, 1937.

SAVANNAH SPARROW. *Passerculus sandwichensis*

F36120, banded at McMillan, Mich., on August 4, 1931, by O. M. Bryens, was retrapped May 15, 1936, and May 21, 1937 at same place.

*F91184, banded at McMillan, Mich., on August 6, 1932, by O. M. Bryens, was retrapped May 4, 1935 and June 25, 1937. Found dead July 30, 1937 at same place.

*H36564, banded at McMillan, Mich., on July 6, 1933, by O. M. Bryens, was retrapped May 16, 1934, July 15, 1935, July 6, 1936, and June 14, 1940 at same place.

VESPER SPARROW. *Pooecetes gramineus*

B91717, banded at Blaney Park, Mich., on May 12, 1933, by K. Christofferson, was retrapped at same place May 11, 1939.

C145534, banded at Princeton, Mass., on September 6, 1933, by L. B. Chapman, was retrapped at same place June 30, 1936, and July 2, 1938.

L1880, banded at North Eastham, Cape Cod, Mass., on August 28, 1933, by O. L. Austin, was retrapped at same place, May 4, 1935, July 21, 1936, July 19, 1937, and April 16, 1938.

SLATE-COLORED JUNCO. *Junco hyemalis*

685453, banded at Wyncote, Pa., on January 10, 1929, by Miss Esther Heacock, was retrapped at same place January 1, 1935.

A138516, banded at Chestnut Hill, Philadelphia, Pa., on February 20, 1934, by John Dornan, was retrapped at same place February 2, 1937 and January 11, 1939.

A142766, banded at Oliverea, N. Y., on May 6, 1929, by Mrs. Florence K. Daley, was retrapped at same place April 25, 1934.

F22558, banded at Overbrook, Pa., on November 6, 1930, by Henry P. Baily, was retrapped at same place January 20, 1937.

F59172, banded at Groton, Mass., on December 3, 1931, by W. P. Wharton, was retrapped at same place December 9, 1937.

F62254, banded at Washington, D. C., on December 19, 1931, by John Molter, was retrapped at same place December 3, 1936 and April 13, 1937.

F98275, banded at Bar Harbor, Maine, on April 13, 1933, by Mrs. Effie A.

Anthony, was retrapped at same place April 19, 1938.
L8707, banded at Newton Center, Mass., on December 4, 1933, by F. H. Kennard, was retrapped at Cambridge, Mass., April 8, 1938.
34-21352, banded at Chestnut Hill, Philadelphia, Pa., on February 26, 1934, by John Dornan, was retrapped at same place April 9, 1937 and January 12, 1939.

JUNCO. *Junco oreganus*

A61615, banded at Barkerville, B. C., on April 28, 1927, by T. T. McCabe, was captured and released at Kitimat Mission, B. C., April 20, 1934.
H72836, banded at Grand Canyon, Ariz., on December 14, 1932, by E. D. McKee, was retrapped at same place October 19, 1938.
L43591, banded near Berkeley, Calif., on November 22, 1933, by E. L. Sumner, was retrapped at same place February 14, 1938.
F59898, banded at Salem, Ore., on October 17, 1931, by F. M. Erickson, was retrapped at same place February 1, 1937.

RED-BACKED JUNCO. *Junco phaeonotus*

H72661, banded at Grand Canyon, Ariz., on December 17, 1932, by E. D. McKee, was retrapped at same place November 24, 1938.
H72690, banded at Grand Canyon, Ariz., on December 10, 1932, by E. D. McKee, was retrapped at same place November 25, 1938.
H72824, banded at Grand Canyon, Ariz., on December 10, 1932, by E. D. McKee, was retrapped at same place December 15, 1937, March 21, 1938 and November 25, 1938.

TREE SPARROW. *Spizella arborea*

A140497, banded at Amherst, Mass., on January 15, 1931, by Mrs. F. M. Cutler, was retrapped at same place February 17, 1932, February 9, 1933, December 18, 1933, November 24, 1935, March 13, 1937, April 12, 1937, and November 19, 1937.
B129607, banded at Ithaca, N. Y., on January 27, 1931, by A. C. Fraser, was retrapped at same place January 1, 1932, November 27, 1932, November 18, 1933, December 3, 1934, December 13, 1935, March 10, 1937, and December 19, 1937.
B170312, banded at Norristown, Pa., on February 21, 1932, by R. J. Middleton, was retrapped at same place December 1, 1938, the fifth return.
C171621, banded at Pequannock, N. J., on February 12, 1933, by Gustave Dumont, was retrapped at same place January 14, 1939, the sixth return.
C185357, banded at Pequannock, N. J., on March 17, 1933, by Gustave Dumont. was retrapped at same place January 16, 1938, the fourth return.
F39680, banded at Jamestown, N. Dak., on April 6, 1932, by G. L. Berner, was shot at Alva, Okla., about January 1, 1937.
F76438, banded at Lenox, Mass., on December 15, 1932, by S. M. Pell, was retrapped at same place January 8, 1938 and November 23, 1938.
H51480, banded at Demarest, N. J., on February 15, 1933, by B. S. Bowdish, was retrapped at same place January 21, 1937 and December 7, 1937.
H55443, banded at Branchport, N. Y., on December 11, 1932, by Verdi Burtch, was retrapped at same place February 16, 1938.

CHIPPING SPARROW. *Spizella passerina*

B80841, banded at Beachton, Ga., in the spring of 1929, by S. H. Stringer, was shot at same place March 8, 1938.
C64747, banded at Sanbornton, N. H., on October 7, 1932, by E. C. Weeks, was retrapped at same place October 15, 1937.
F22491, banded at Winter Harbor, Maine, June 26, 1932, by J. P. Wetherill, Jr., was retrapped at same place July 8, 1938.
F22755, banded at Summerville, S. C., on March 2, 1931, by W. P. Wharton,

was retrapped at same place April 9, 1937.

F67318, banded at Summerville, S. C., on February 15, 1932, by W. P. Wharton was retrapped at same place March 10, 1937.

H91522, banded at Groton, Mass., on May 8, 1933, by W. P. Wharton, was, retrapped at same place May 11, 1936 and April 27, 1937.

H91525, banded at Groton, Mass., on May 8, 1933, by William P. Wharton, was retrapped same place May 2, 1939, April 27, 1940, and October 3, 1940, when band was replaced by 40-1538.

H92413, banded at North Eastham, Cape Cod, Mass., on October 13, 1933, by O. L. Austin, was retrapped same place May 10, 1940.

35–31420, banded at Beltsville, Md., on April 25, 1935, by W. M. Davidson, was retrapped same place September 13, 1938, March 30, 1939, and April 17, 1940.

FIELD SPARROW. *Spizella pusilla*

F67334, banded at Summerville, S. C., on February 20, 1932, by W. P. Wharton, was retrapped at same place March 2, 1937.

H27290, banded at Elmhurst, L. I., N. Y., on October 21, 1932, by Mrs. Marie V. Beals, was shot at York, Pa., April 7, 1937.

L20971, banded at Summerville, S. C., on April 11, 1931, by W. P. Wharton, was retrapped at same place March 13, 1937.

L39594, banded at North Eastham, Cape Cod, Mass., on April 15, 1934, by O. L. Austin, was retrapped October 22, 1939, at the same place.

34-8239, banded at Nashville, Tenn., on October 5, 1934, by Mrs. F. C. Laskey, was retrapped same place March 20, 1935, March 25, 1936, March 17, 1937, April 3, 1938, March 20, 1939, and March 23, 1940.

34-33523, banded at Ithaca, N. Y., on August 15, 1934, by A. C. Fraser, was retrapped October 23, 1935, April 22, 1937, and April 25, 1939, same place.

HARRIS'S SPARROW. *Zonotrichia querula*

124795, banded at Fairbury, Nebr., on January 3, 1925, by Agness and Susie Callaway, was retrapped same place April 18, 1928, February 17, 1929, November 8, 1929, and April 26, 1931.

176079, banded at Fairbury, Nebr., on December 23, 1925, by Agness and Susie Callaway, was retrapped same place February 17, 1929, December 9,1929, February 23, 1930, and February 23, 1933.

511130, banded at Fairbury, Nebr., on December 15, 1927, by Agness and Susie Callaway, was retrapped same place April 2, 1929, November 6, 1929, April 4, 1931, April 9, 1934, and November 4, 1934.

697484, banded at Chapman, Kans., on December 10, 1932, by W. N. Wilkins, was retrapped same place December 9, 1933, March 19, 1939, and February 13, 1941.

34-107247, banded at Chapman, Kans., on January 1, 1934, by W. N. Wilkins, was retrapped same place March 21, 1939, and January 21, 1940.

WHITE-CROWNED SPARROW. *Zonotrichia leucophrys*

*569909, banded at San Francisco, Calif., on September 1, 1930, by F. N. Bassett, was found dead at San Francisco, Calif., April 28, 1938.

*A178778, banded at Berkeley, Calif., on June 19, 1930, by E. D. Clabaugh, was retrapped at same place September 17, 1937.

B124047, banded at Berkeley, Calif., on November 23, 1930, by E. D. Clabaugh, was shot at same place about August 5, 1940.

GOLDEN-CROWNED SPARROW. *Zonotrichia coronata*

123932, banded at Stanford University, Calif., on February 16, 1924, by P. N. Baxter, was retrapped same place January 6, 1928, and November 30, 1930.

150448, banded at Stanford University, Calif., on December 9, 1924, by G. H.

Offerman, was retrapped same place December 5, 1930 and March 7, 1931.

A176908, banded at Woodacre, Marin County, Calif., on October 20, 1930, by J. Mailliard, was retrapped at same place October 25, 1936, December 5, 1937, and March 26, 1938.

C102454, banded at Benicia, Calif., on December 21, 1932, by E. A. Stoner, was retrapped at same place February 10, 1937.

WHITE-THROATED SPARROW. *Zonotrichia albicollis*

A197232, banded at Summerville, S. C., on January 7, 1931, by W. P. Wharton, was retrapped at same place January 26, 1937, and rebanded with 36-125387.

FOX SPARROW. *Passerella iliaca*

B191126, banded at Oradell, N. J., on November 15, 1931, by Mrs. C. L. Bull, was recovered on Pelleys Island, Newfoundland, December 28, 1936.

C160076, banded at Pomfret, Conn., on November 11, 1932, by Mrs. K. B. Wetherbee, was retrapped at St. Pierre Island, near Newfoundland, April 10, 1937.

C169173, banded at Ambler, Pa., on March 11, 1933, by Charles Platt, was captured at Franklin, Conn., March 13, 1939.

SONG SPARROW. *Melospiza melodia*

A124267, banded at Demarest, N. J., on April 15, 1929, by B. S. Bowdish, was retrapped at same place March 11, 1934, and rebanded with F120982.

A132620, banded at Hillsdale, Mich., on April 21, 1931, by B. A. Barber, was retrapped at same place April 9, 1936.

A162476, banded at Branchport, N. Y., on September 21, 1929, by Verdi Burtch, was retrapped 2 miles north of Branchport, N. Y., March 30, 1937.

B102111, banded at Harvard, Mass., on September 20, 1930, by J. L. Peters, was retrapped at same place August 8, 1936.

B130907, banded at Branchport, N. Y., on July 23, 1931, by Verdi Burtch, was retrapped at same place August 15, 1936.

*B165736, banded at Gates Mills, Ohio, on July 23, 1931, by S. P. Baldwin, was retrapped at the same place June 5, 1932, July 10, 1933, June 8, 1934, April 15, 1935, July 2, 1936, and July 18, 1937, when it was rebanded with F20302.

*B174251, banded at Winter Harbor, Maine, August 3, 1932, by J. P. Wetherill, Jr., was retrapped at same place July 15, 1937 and July 7, 1938.

B194235, banded at Komoka, Ont., on July 20, 1932, by J. C. Higgins, was retrapped July 27, 1938, at the same place and band 34-122852 added.

*C76579, banded at Winter Harbor, Maine, July 19, 1931, by J. P. Wetherill, Jr., was retrapped at same place July 20, 1936.

C111312, banded at Groton, Mass., on May 24, 1932, by W. P. Wharton, was retrapped at same place August 3, 1936 and April 21, 1937.

C142992, banded at Waynesville, N. C., on June 26, 1933, by Miss Marion A. Boggs, was retrapped at same place April 25, 1938.

*F35260, banded at North Eastham, Mass., on June 25, 1931, by O. L. Austin, was retrapped at same place June 28, 1936.

F51215, banded at Lisle, Ill., on October 1, 1931, by E. Jurica, was retrapped at same place April 9, 1937, the sixth return.

*H75001, banded at Demarest, N. J., on August 7, 1933, by Keahon Garland, was retrapped at same place April 3, 1938.

H88704, banded at Ottawa, Ont., on April 23, 1933, by R. E. DeLury, was retrapped at same place June 25, 1934, April 8, 1935, April 26, 1936, and May 9, 1937.

*C149409, banded at Greenwich, Conn., on June 30, 1933, by Miss M. G. Willson, was killed by auto at Elmsford, N. Y., March 27, 1939.

SNOW BUNTING. *Plectrophenax nivalis*

B80275, banded at McMillan, Luce County, Mich., on February 28, 1929, by Oscar M. Bryens, was retrapped at the same place January 21, 1931, February 19, 1933, and January 20, 1934.

L73527, banded at McMillan, Mich., on February 22, 1934, by Oscar M. Bryens, was retrapped at same place February 3, 1936, January 27, 1938, and February 15, 1941.

U. S. Fish and Wildlife Service, Washington, D. C.

GENERAL NOTES

Sex Ratio in Oklahoma Tree Sparrows (*Spizella arborea*).—Several years ago I submitted partial evidence (Heydweiller, 1935 and 1936) for the theory that Tree Sparrows segregate in winter, with the female range somewhat farther south than the male. This postulation was based on large series of birds collected at Ithaca, New York, Indianapolis, Indiana, and some two hundred Kansas specimens loaned by the Museum of Zoology at Lawrence, Kansas. Thus I had material from the northern and central parts of their range.

Three years ago we moved to Oklahoma, reasonably near the southern extension of Tree Sparrow range. Between affairs purely domestic I have tried to check the truth of this theory, with results both puzzling and highly satisfactory.

Specimens collected during the winter 1940–1941, when Tree Sparrows were the most abundant winter bird in the Stillwater area, were in precisely the reverse of the sex ratio at Ithaca, New York, and consequently in complete accord with my theory. The original table can now be completed as follows:

Part of Range of Species	*Locality*	*No. of Winter Males*	*Females*
North	New York State (Chiefly from Ithaca, personal collection, 1933–1935)	102	31
Central	Indiana (Indianapolis, col. Jan. 1935, dissected by A. M. H.)	16	22
South Central	Kansas (U. S. Biol. Surv. and University of Kansas collections)	185	158
South	Oklahoma (Stillwater, personal collection, 1940–1941)	31	78

The 1939–1940 collection, however, was highly puzzling, and I submit the following unanswered problems for what they are worth. During this winter Tree Sparrows were relatively infrequent in the Stillwater area. In spite of a vigorous campaign to collect them in quantity, only 39 were bagged the entire season, yielding the disconcerting ratio of 28 males (72%) and 11 females (28%). While these figures were too meager to consider representative, the proportions throughout the season remained too consistently in favor of the males to ignore.

One explanation that sounded plausible was that the bulk of the Tree Sparrows might have travelled farther south that year, an excessively severe winter in Oklahoma, giving this state the sex proportions usually found in the northern states. To test this postulation a table was made of Tree Sparrow records in the Bird Lore Christmas Censuses from 1936 through 1941, covering the two tiers of states immediately west of the Mississippi. However subject to variables in man hours, weather, and possible inaccuracies, these records still indicated unquestionably that the center of Tree Sparrow abundance in 1939–1940 occurred at the Iowa and Kansas level, with unprecedented numbers at every station and sub-normal figures to the extreme north and south. During the following winter (1940–1941) they seem to have distributed themselves more evenly, with sharp

declines in the central states and reasonable abundance both north and south. Thus the figures completely upset explanation one.

Another possibility is that males may be more conspicuous, perching higher and in more vulnerable positions, so that in a lean year the numbers collected would be out of all proportion to the actual sex ratio.

Other suggestions are also welcome. Whatever the explanation for that first winter, the figures during the second (1940–1941) adequately substantiate my original theory: that Tree Sparrows segregate in winter, with the bulk of the female population farther south than the male.

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1936. Sex, age and individual variation of winter tree sparrows. *Bird-Banding.* 7(2): 66–67.

—A. Marguerite Baumgartner, Stillwater, Oklahoma.

A Case of Reversed Migration.—Eastern Song Sparrow (*Melospiza m. melodia*) No. 39-168058, banded at Wells River, Vermont on April 16, 1939 was killed by a cat at East Jaffrey, N. H. on June 19, 1939 as reported by T. I. Urquhart. East Jaffrey is approximately 90 miles south of Wells River.

Observers have frequently noted reversed movement in correlation with unseasonable weather. In this case there were no snow storms following the date of banding nor periods of unusually low temperatures but the average temperature for April, 1939 was below that of a ten-year period by 4.98 degrees while the May average for the same year was 3.01 degrees lower than that of the longer period.—WENDELL P. SMITH, Wells River, Vermont.

A White-crowned Sparrow Recovery.—White-crowned Sparrow (*Zonotrichia l. leucophrys*) No. 39-168082 banded at Wells River, Vermont on May 20, 1939 was retaken on January 7, 1942 at Marmaduke, Arkansas, by M. Obbards.—WENDELL P. SMITH, Wells River, Vermont.

Return of a Banded Cripple.—In trapping sparrows on the roof of McGilvrey Hall on the campus of Kent State University, Kent, Ohio, the writer captured a male English sparrow, *Passer domesticus domesticus* L., which had the left leg broken off at the end of the tibia. The bird was trapped on June 15, 1941, in an ordinary sparrow trap with five other English Sparrows and was banded with Biol. Surv. band 136169. In the trap the crippled bird seemed to get around and feed without difficulty and to compete successfully with the other birds. The following spring this crippled bird returned, and was found dead in the trap on May 14, 1942, eleven months after being released.—RALPH W. DEXTER, Kent State University, Kent, Ohio.

Returns from Banded Birds.—The following returns have been selected as of special interest from among 92 returns covering seventeen species which I reported to the Fish and Wildlife Service for the fiscal year 1941–1942.

38-215844. Brown Thrasher. Adult. Banded August 31, 1938. Return (1) June 18, 1940; (2) June 15, 1941; (3) April 29, 1942. At least 5 years old.

39-167142. Wood Thrush. Adult. Banded May 20, 1939. Return (1) May 6, 1942. At least 4 years old.

38-213134. Starling. Adult male. Banded May 14, 1938. Return (1) May 15, 1942. At least 5 years old.

37-324740. Purple Grackle. Adult. Banded May 20, 1938. Return (1) May 14, 1938; (2) May 17, 1942. At least 5 years old.

38-64854. Purple Finch. Adult male. Banded April 14, 1938. Return (1) March 27, 1942. At least close to 6 years old.

37-99389. Slate-colored Junco. Adult male. Banded October 24, 1937. Return (1) November 24, 1938; (2) November 7, 1939; (3) October 26, 1941. At least 5 years old.

39-128738. White-throated Sparrow. Adult. Banded December 24, 1938. Return (1) April 26, 1940; (2) November 11, 1940; (3) March 7, 1942. At least 5 years old.—HORACE GROSKIN, 210 Glenn Road, Ardmore, Pa.

Roadside Returns.—On both June 5 and 6, 1942, banded birds were found killed on roads about a third of a mile from the banding station. On the first date, Song Sparrow 41-94024 was found within a few hundred yards of the place where it had been banded on August 1, 1941, when it was a juvenile. It had not been trapped since it repeated on September 21, 1941.

Early in the morning of June 6, 1942, Robin 38-248751 was found. This bird was banded on July 4, 1939 as a juvenile, the notes indicating that it was host to bird flies (*Hippoboscidae*) at that time. It had not been taken since it was banded nearly three years previously.

The automobile was indicated in both cases as being responsible for the death of these birds. One was found crushed in the wheel tracks; the other mangled at the edge of the roadside. In one instance this was a narrow road, and in the other a fairly wide, paved highway.

The loss of bird life through this hazard seems to reach high levels during the nesting season, much of it due, no doubt, to the preoccupation of the birds with territory-holding, courting and nesting. Still other factors may have been at work in the instances referred to above. Preceding the finding of these birds, skies had been overcast with considerable misting. Vegetation was dripping wet. Under such conditions, it would seem entirely possible that birds' plumages would become dampened to a degree that would lessen their efficiency on the wing, especially if they persisted in attempts to garner food from ground levels. These very factors may be partly responsible for birds resorting to the hazardous habit of gleaning insect food from roadsides.—EDWIN A. MASON, Wharton Bird Banding Station, Groton, Massachusetts.

Longevity Records of Finches Banded at Lexington, Mass.—The following returns at my bird-banding station, Woodland Bird Sanctuary, may prove of interest.

ROSE-BREASTED GROSBEAK (*Hedymeles ludovicianus*)

♂ banded as 2 year old June 20, 1938; Returned June 1, 1939; May 8, 1940; May 13, 1941; May 3, 1942.

♂ banded, May 29, 1940. No record 1941; returned May 5, 1942.

♂ banded, May 17, 1939. No record 1940; returned July 31, 1941; May 5, 1942.

♂ banded June 26, 1937. Returned June 10, 1938; June 10, 1939; May 17, 1940; June 6, 1941; May 5, 1942.

♂ banded June 27, 1939 (probably 2 year old). Returned May 24, 1940; May 13, 1941; May 5, 1942.

♀ banded as juv. July 7, 1934. Returned May 20, 1935; May 13, 1936; May 14, 1937; June 13, 1938; May 23, 1939; May 29, 1940; June 5, 1941; June 22, 1942.

♀ banded May 26, 1934. Returned May 29, 1935; June 21, 1936; May 17, 1937; June 30, 1938; July 2, 1939.

♀ banded July 25, 1935. Returned June 17, 1936; June 11, 1937; June 22, 1938; May 18, 1939; May 9, 1940.

INDIGO BUNTING (*Passerina cyanea*)

♀ banded May 21, 1939. Returned May 15, 1940; no record 1941; May 5, 1942.

CHEWINK (*Pipilo erythophthalmus erythrophthalmus*)

♀ banded as adult August 23, 1936. Returned July 12, 1939; July 11, 1940; May 3, 1942.
♀ banded as immature July 27, 1938. Returned June 11, 1940; May 4, 1942.
—ADA CLAPHAM GOVAN, Woodland Bird Sanctuary, Lexington, Mass.

Trapping Spotted Sandpipers and Baltimore Orioles with Unusual Bait.—At my banding station, established in 1921 at Lily Pond, Cohasset, I have trapped and banded in one year as many as 27 species, one of which is the Spotted Sandpiper (*Actitis macularia*). I had on my lawn, some distance from the house, a large, pull-string trap for taking robins. In this trap I placed a quantity of "sun-kissed" raisins, which was successful bait for them. After most of the birds had been trapped and banded, I still continued the raisins, which in the warm weather, and after rains, became decayed; and then came many fruit flies that like decaying fruit. The Spotted Sandpipers nest around the pond, and have a habit of coming on the lawn for insects in the grass, and, as they neared the trap, they spied the flies and went directly in after them. In that way, the birds were taken;—inadvertently by the raisins used as bait for the robins.

For years the Baltimore Orioles (*Icterus galbula*) have nested in my elms. One of three nests was located on the hanging branches of an elm, about eighteen feet from the ground, directly over the traps. In experimenting with various kinds of bait for insectivorous birds, I discovered that bread crumbs in the trap, with larger pieces on top would attract them. In placing this bait in and on the trap under the orioles' nest, I was successful in having the female oriole enter, and instead of taking the bird immediately, I thought I would see if she would be good bait for her mate. It was not long before the male joined the female in the trap.—LAURENCE B. FLETCHER, Lily Pond, Cohasset, Mass.

Shipping Specimens for Diagnosis.—It is very difficult to make general recommendations for the preservation and shipping of specimens for diagnosis because this depends on distance, transportation facilities, season and the nature of the disease in the specimen.

Fortunately the area from which our specimens come is small so that packages usually arrive the day after mailing and the specimens are fairly well preserved. Nevertheless, we do receive decomposed specimens but this is often due to delays in transit over the week end. In other cases the specimen was dead and probably quite decomposed when it was found. Decomposition due to delays in shipments on week ends and holidays may be partly avoided by holding the specimen under refrigeration over the week end or holiday. Obviously, nothing can be done to restore a specimen already decomposed at the time of finding.

The use of dry ice to preserve specimens is rather expensive and should not be used whenever the diagnosis must depend upon a microscopic examination of a blood smear. Frozen blood becomes hemolyzed so that malarial infections, for example, cannot be diagnosed.

Packing the specimen in powdered borax has been suggested, and in our limited experience has seemed to give satisfactory results regardless of the disease present.

Some diseases can be diagnosed however decomposed the specimen. The diagnosis of tuberculosis, for example is, made by a microscopic examination of a stained slide made from the lesion. The presence of other bacteria are of no consequence because the tubercle bacillus can be easily identified by its staining properties. Parasites are usually well preserved even in specimens showing advanced decomposition.

The diagnosis of a virus disease in a decomposed specimen is not impossible for the reason that most viruses have to be filtered in any event. On the other hand, pox scabs may be suspended and inoculated without filtration. Decomposition may, however, obliterate changes which would otherwise suggest a virus disease, and hence, prompt a search for it.

Decomposition is most troublesome when one is attempting to diagnose a bacterial infection. The colon organism which invades the tissues from the intestine is such a prolific grower that it tends to obscure the growth of the real causative organism. Likewise, decomposition destroys blood cells so that a microscopic examination of a blood smear is not satisfactory.

The most common error made in shipping a specimen is to wrap it in oiled paper or place it in some air-tight container. Under these conditions anaerobic conditions are created so that the putrefactive bacteria bring about marked changes in a short time.—F. R. BEAUDETTE, New Jersey State Agricultural Experiment Station, New Brunswick, N. J.

RECENT LITERATURE

Reviews by Margaret M. Nice

BANDING

1. Report of the Bird-Ringing Committee. Progress for 1941. A. L. Thomson. 1942. *British Birds*, 35 : 267–271. "The war has caused a heavy reduction in the number of birds ringed", and "the total of 7,099 is the smallest for any year since 1920." A 14 year old Lapwing is reported. Species banded in largest numbers since 1909 are respectively: Starling (*Sturnus vulgaris*), Song Thrush (*Turdus ericetorum*), Blackbird (*Turdus merula*), Swallow (*Hirundo rustica*), Lapwing (*Vanellus vanellus*), Chaffinch (*Fringilla coelebs*), Greenfinch (*Chloris chloris*), British Robin (*Erithacus rubecula*), Manx Shearwater (*Puffinus p. puffinus*).

2. Bird-Banding of the Natural History Museum of Göteborg in 1940. (Göteborgs Naturhistoriska Museums Ringmärkningar av Flyttfåglar under 1940.) L. A. Jägerskiöld. 1941. *Göteborgs Musei Arstryck* 1941 : 65–80. In 1940 5,203 individuals of 114 species were ringed by the Göteborg Museum, making a total since 1911 of 114,044; recoveries and returns amount to 3,862, or 3.4 per cent. The species banded in largest numbers are respectively: Black-headed and Common Gulls (*Larus ridibundus, L. canus*), Starling, Common, Arctic and Sandwich Terns (*Sterna hirundo, S. paradisaea,* and *S. sandvicensis*), Lapwing, Great Tit (*Parus major*), House Martin (*Delichon urbica*) and Swallow.

3. Banding Records of California Brown Pelicans. Richard M. Bond. 1942. *Condor*, 44 : 116–121. Of 555 young *Pelecanus occidentalis californicus* banded in West Anacape Island in 1939 and 1940, 63 recoveries (12 percent) have been reported from as far distant as 550 miles south and 1400 miles north; an epidemic of parathyroid in southern California probably accounts for about one-third of the records.

4. La Migracion de Aves en el Hemisfero Occidental. (Bird Migration in the Western Hemisphere.) F. C. Lincoln. 1942. International Committee for Bird Preservation, 1006 Fifth Ave., N. Y. C. 12 pp. A good popular account in Spanish and English of migration in North and South America, with some account of banding, and mention of species marked in North America and taken in Central and South America. Maps of the migration of the Golden Plover and Bobolink are included.

See also Nos. 16, 33 and 36.

LONGEVITY

5. Longevity and Other Data on a Captive English Sparrow. Dayton

Stoner. 1942. *Auk*, 59 : 440–442. A male *Passer domesticus*, adopted as a small nestling, lived for twelve years. He was afraid of red in his food, the cover of his cage, and in the apparel of persons. He imitated excellently the songs of two canaries kept in the same room.

See also No. 1.

LIFE HISTORY

6. The Nest Life of the Turkey Vulture. T. H. Work and A. J. Wool. 1942. *Condor*, 44 : 149–159. An account of thirteen visits to a nest of *Cathartes aura* in California with excellent pictures of the young from hatching to fledging. The adult flushed from the eggs, but remained with the young till they were two weeks old, even when handled by the observers. The maximum increase in weight of the young came between the fifteenth and twentieth weeks. The two young were antagonistic to each other during their second month. They left at 62 to 65 days of age.

7. Life History of the Mexican Trogon. A. F. Skutch. 1942. *Auk*, 59 : 341–363. A fascinating account of the Aurora (*Trogon mexicanus*) in Guatemala. Nesting cavities are excavated in decayed stumps. Both parents incubate the two eggs, the female at night and for longer periods in the daytime than the male. The young stay in the nest 15 and 16 days. One male brought food to his two and three-day nestlings, but held it in his bill as he brooded instead of delivering it; during the morning each parent brought food five times; the female fed the young each time, but the male did so only once! Two days later, however, he delivered all the insects he brought (p. 352). Trogons are quiet and dignified; they never fight each other nor molest other birds. They snatch insects and berries in flight (p. 358). The incubation period for three species was 19 days. In one nest of the Quetzal (*Pharomachrus mocinno costaricensis*) fledging took 23 days, in another that was very high, one month.

8. Notes on Hummingbirds at Chiriqui, Panama. C. Brooke Worth. 1942. *Auk*, 59 : 364–368. Several species utter songs from perches much as do passerines. The hum of most of the Hummingbirds was "about three octaves below middle C, which suggests sixty-four vibrations per second" (p. 365). By means of his faculty of "absolute pitch," the author judged that the number of wing-beats per second ranged from 60 to 72, the highest figure occurring when feeding. A Bangs' Hermit (*Phaëthornis guy coruscus*), probing banana blossoms, was kept away from an area by a large insect, perhaps "one of the carnivorous nocturnal crickets."

9. The Birds of a Bull's Horn Acacia. O. S. Pettingill, Jr. 1942. *Wilson Bulletin*, 54 : 89–96. Biting and stinging ants (*Pseudomyrma*) inhabit the hollow thorns of the bull's horn acacia in Mexico; they attack persons touching the shrub, but not the Derby and Social Flycatchers (*Pitangus sulphuratus texanus*, *Myiozetes similis texensis*) that nested in it. Both sexes of both species of flycatchers build the nest, in contrast to Tyrannidae in temperate North America, where, so far as known, only the females build. The Derby Flycatchers took 24 days in which to build their nest; Tyrannidae in temperate North America are reported as taking from 3 to 13 days. Social Flycatchers always seem to build near some other species, apparently "because of the latter's ability to drive off larger enemies" (p. 95). A delightful paper.

10. Nesting Habits of the Eastern Phoebe. Wendell P. Smith. 1942. *Auk*, 59 : 410–417. Observations on *Sayornis phoebe* in Wells River, Vt., from 1935 to 1937. Incubation lasted 14 to 17 days, fledging 15 to 17, while parental care extended two to three weeks longer. Correlation is shown between average weekly temperatures and the arrival of the species, the taking up of territory,

starting nest building and beginning egg laying. Some renewal of courtship was seen after the broods left the nest, but no second broods were attempted during these three years, although two broods had been raised in 1932, after the first brood had left June 16, while in 1935–37 the young left July 2, June 24 and June 29 respectively. In Pelham, Mass., some 140 miles south of Wells River, I found that two broods are regularly raised. In 1925 one pair's young left June 12 and July 16; the other pair's young left June 13 and July 25; in 1940 the first brood left June 15, the second July 31. Fledging periods lasted 15, 16, 17, 18 and 19 days. Six first broods fledged 18 young, an average of 3; three second broods fledged five young, an average of 1.7. The average of the nine broods was 2.6. If the averages for the first and second broods are added, they come to much the same as the average of the three single broods in Vermont—4.3.

11. International Swallows. Minna A. Common. 1942. *Auk*, 59 : 437. Colonies of Tree Swallows (*Iridoprocne bicolor*) nest on ferryboats that ply between Ogdensburg, N. Y. and Prescott, Ontario, where the St. Lawrence is a mile wide. "No bird ever seems at a loss as to the whereabouts of its homesite." Nesting materials and food are gathered from either shore.

12. Long Incubation by a Carolina Chickadee. E. P. Odum. 1942. *Auk*, 59 : 430–431. A female *Penthestes carolinensis* incubated infertile eggs for 24 days.

13. Breeding Behavior of Bell's Vireo in Illinois. F. A. Pitelka and E. J. Koestner. 1942. *Wilson Bulletin*, 54 : 97–106. One pair of *Vireo b. belli* built four nests in which five Cowbird (*Molothrus ater*) eggs were laid; the first three nests were deserted; in the last, two Vireos were raised. The incubation period was 14 days, fledging 11 days. The female built, both birds incubated and fed the young. Intervals between the destruction of a nest and the first egg of the next were 5, 6 and 5 days respectively. Between May 26 and June 20 the female laid twelve eggs. Once she sang as she approached the nest from which her incubating mate had just left.

14. The Cardinal: the Bird Itself. Bayard H. Christy. 1942. *Cardinal*, 5(8) : 173–186. An historical account of *Richmondena cardinalis*, with reproductions of the two earliest pictures of the species, one by Aldrovandus in 1599, the other by D'Hondecoeter in the 17th century. The northward spread of the Cardinal concomitant "with the northward shift of isotherms consequent upon the deforesting of our continent" is mentioned. This bird "is seldom seen at the bird bath"; in my experience female Cardinals bathed fairly often, but I never saw a male do so and have heard of only one such instance. A section on "Habits" is given by Maurice Brooks who notes the wildness of those individuals occasionally found in deep woods; Mr. H. R. Ivor mentions the same trait in these birds near Toronto, Ontario, where they are near the border of their range.

See also no. 36.

BIRD BEHAVIOR

15. Display and Sexual Behavior of the Brandt Cormorant. Laidlaw Williams. 1942. *Condor*, 44 : 85–104. A very interesting article with photographs and excellent line drawings of the birds' postures. Nesting colonies of *Phalacrocorax pencillatus* on offshore islands off southern California were watched through a telescope, so that the birds were entirely undisturbed. Sexes were distinguished by the larger bill size of the males, while certain birds were identified by peculiarities of plumage. Nuptial plumes appear in December and last through July; at the same time the gular pouch becomes a brilliant cerulean blue. In large colonies downy young may be seen from May through July. There are three phases in the reproductive behavior: I, Advertising Display by the males and

Visiting by the females; II, Pairing up, temporary or permanent, Mutual Displays; III, Incubation and Rearing of young.

In Phase I the male takes a station and carries nesting material to it. His advertising display consists of the *flutter* and *stroke*. When the females move about with thin, upstretched necks, peering at one advertiser, then at another, there is a sudden increase in display activity. In Phase II, as soon as a female reaches a male, mutual displays start; the male does not advertise when a female is with him.

The male goes into the lower pre-coitional position and the female may mount. If the female stays, the male mounts, they copulate and he leaves for nesting material. The birds intimidate with the *threat gesture* and *peck threat*. Occasionally a male uses the peck threat against a female with which he had been doing mutual displays, whereupon she precipitously leaves. A threatened male replies in kind and the two may grip bills. Threat displays are also used against Western Gulls (*Larus californicus*) and Murres (*Uria aalge*); Cormorants on nests threaten Sea Lions, that stop, at least temporarily, in their advance. "A murre passing through a group of cormorants is pecked and threat-gestured from all sides" (p. 93).

In Phase III nest relief is the only new ceremony. The female protects her nesting material by threat-display. The birds get dry stuff, sometimes by stealing, get land plants, and dive for marine plants; they may stay under water for 23.4 seconds. The male gathers most of the material.

"This colonial bird has an individual territory, although the area defended is only a few square feet around the nest. The males advertise at this place and keep other males away; the females come there for copulation and the nest is built there" (p. 103).

Comparisons are made with the display behavior of three other species. The author queries, "Might it not be possible that in *pencillatus* voice has not been particularly evolved, display effects being achieved by striking posture and the brilliance of the pouch alone, whereas *carbo* has developed a striking pattern of plumage and posture, but particularly voice, and *auritus* perhaps has some degree of all three qualities, pattern, posture, and voice?" (p. 101). A valuable study

16. Pairing Responses of Free-Living Valley Quail to Sex-Hormone Pellet Implants. J. T. Emlen, Jr. and F. W. Lorenz. 1942. *Auk*, 59 : 369–378. A valuable experiment on wild birds. During December and January, pellets of crystalline sex-hormones (testosterone and stilbestrol) were implanted subcutaneously in free *Lophortyx californica vallicola*, that were color-banded and provided with markers in the tail. "The three males treated with testosterone became pugnacious toward other males, but this had no effect on their position in the peck order of the covey." These birds and two females similarly treated "pursued and then paired with a bird of the opposite sex." "The male and the four females treated with stilbestrol showed no behavioral response." Interestingly enough, "Untreated (control) males showed contagious behavior in eight out of ten cases by pairing off in the manner of treated males."

17. Cooperative Feeding of White Pelicans. C. Cottam, C. S. Williams, and C. A. Sooter. 1942. *Auk*, 59 : 444–445. At the Malheur Wildlife Refuge, Oregon, twelve *Pelicanus erythrorhynchos* "assumed a circular position, surrounding the school" of fish; they moved in unison and captured large numbers of their prey. As many as 13,000 Avocets (*Recurvirostra americana*) have been seen in "compact spearhead and wedge formations" sweeping the bottom muck.

18. Genetic Interaction in a Hybrid Pheasant. J. S. Huxley. 1941. *Proc. Zool. Soc., Ser. A*, 111 : 41–43. In the "offspring of one of the most distant crosses recorded in birds," a male hybrid between a female Lady Amherst Pheasant (*Chrysolophus amherstiae*) and male Himalayan Impeyan Pheasant (*Lophophorus impeyanus*), the Impeyan habit of digging with the beak is dominant over the

Amherst habit of scratching with the feet. In plumage characters, the "chief point of interest is the almost complete disappearance of the striking colours and patterns of the two parents, the hybrid being almost entirely black with no or very limited iridescence." The bird has shown no trace of sexual behavior.

19. Development of Young Goshawks. Richard M. Bond. 1942. *Wilson Bulletin*, 54 : 81–88. Excellent account of the behavior of a female *Accipiter atricapillus* taken from a nest in Nevada when four weeks old. Young Accipiters may go through bathing movements "on a bare floor at the mere sight of a sister sloshing about in a bathing pan."

20. Hunting Strategy of Pigeon Hawks. Karl W. Kenyon. 1942. *Auk*, 59 : 443–444. Six *Falco columbarius bendirei* were seen during a train trip from Nogales to Guaymas; these birds had learned to take advantage of the trains' scaring up small birds; "they hung back several cars from the front of the train" and were able to pounce upon their unsuspecting prey.

21. The Brown Jay's Furcular Pouch. G. M. Sutton and P. W. Gilbert 1942. *Condor*, 44 : 160–165. *Psilorhinus morio* in Mexico makes a call sounding. like a hiccup; this seems to come from the "inflation (or perhaps deflation) of a curious little pouch on the jay's chest." This hiccup "was a signal for quiet, stealthy approach, for close attention to some not quite solved problem." A crowd of Jays customarily follows the bird student with strident cries; they will hiccup as they examine a motionless hunter, but burst into screams at the slightest motion.

22. Flight and Running Speeds of Birds. C. Cottam, C. S. Williams, and C. A. Sooter. 1942. *Wilson Bulletin*, 54 : 121–131. Flight speeds were tested by automobile of some 80 individuals, varying from 10 miles per hour with Terns (*Sterna*) and Black Skimmers (*Rhyncops nigra*) to 55 with the Redhead (*Nyroca americana*); also walking speeds of 17 individuals, ranging from 2 miles per hour with the Sage Hen (*Centrocercus urophasianus*), to 5 with the Killdeer (*Oxyechus vociferus*) and 21 with the Ring-necked Pheasant (*Phasianus colchicus torquatus*).

23. Nest Sanitation and an Alleged Releaser. A. L. Rand. 1942. *Auk*, 59 : 404–409. Criticism of Lorenz' and Tinbergen's view "that the circlet of light-colored feathers about the anus of nestling passerines" serves as a "releaser stimulating the adult to remove the feces of the young"; the author stresses the point that the young are hatched without feathers. When criticism on Lorenz' theories are to be made, the 1935 paper on the "Kumpan" should be consulted, not the very short version in the *Auk* that appeared two years later. Lorenz did not say "passerine"; he said Titmice in 1935 (p. 297), and Blue Tit in 1937 (p. 245.) In the crowded conditions of later nest life with ten to a dozen Titmouse nestlings in one small cavity, it is reasonable to believe that such a circlet would be of assistance in nest sanitation, by calling parental attention to the forthcoming sac.

Although Dr. Rand concluded from some experiments with Song Sparrows that "the presence of the young is necessary for nest-sanitation to be carried out", this is not necessarily true with other birds. I have seen a Black-throated Green Warbler remove excreta from an empty nest, and Blair and Tucker (*British Birds*, 1941) report that with the Pied Flycatcher and Wryneck "on the day after the nestlings flew the parent birds returned and cleaned up every particle of excrement, leaving the nest-box clean" (p. 214).

See also Nos. 6–14 and 29, 30, 33, 35 and 36.

EXPERIMENTS WITH LIGHT

24. Effect of Light on the Moults and Sequences of Plumage in the Willow Ptarmigan. Per Höst. 1942. *Auk*, 59 : 388–403. Salomonsen (1939, see *Bird-Banding*, 10 : 166) concluded from a study of skins of the Rock Ptarmigan

(*Lagopus mutus*) "that *temperature* is the external factor controlling the rhythm of plumage changes." With captive *Lagopus lagopus* in Norway, Höst noted "a marked synchronization of the plumage cycle with the different phases of reproduction." By means of artificial lighting from November to February he brought birds into the spring molt and even into laying despite low temperatures, while curtailed light brought on winter plumage even when temperature was high. (Nothing is said as to the relative warmth of the different plumages; one would expect a Ptarmigan in spring plumage in mid winter to suffer from the cold.)

25. Some Effects of Flashing Light on Testicular Activation in the Male Starling (*Sturnus vulgaris*). J. W. Burger, T. H. Bissonnette, and H. D. Doolittle. 1942. *Journ. Exp. Zool.*, 90 : 73–82. "To a basic day of uninterrupted lighting, too short to be activating sexually to male starlings, periods of flashing light were added. . . . The combined daily treatment was . . . 14 hours. Controls . . . received 14 hours of uninterrupted illumination. . . . In all cases, the birds remained awake throughout the daily periods of light-experiments." Control Starlings formed sperm; those treated with flashing light did so when the interval of darkness between successive flashes was less than 15 seconds and the flashes were at least 0.9 second in length. "It was found that wakefulness, as such, did not result in testicular activation. It is concluded on the basis of the above and other work, that light, as light, is the primary stimulus for testicular activation in the male starling. It has been found that within limits, the light stimulus is quantitatively related to the rate and degree of testicular response."

ECOLOGY

26. Population study on a Region in the Lower Limmat Valley. (Besiedlungstudie über ein Gebiet im unteren Limmattal.) W. Epprecht. 1942. *Ornithologische Beobachter*, 39 : 53–66. An annotated list of 45 species nesting in a region of four square kilometers west of Wettingen, Switzerland. A map shows the major ecological niches and the occurrence of pairs of 25 species. Notes are given on territorial relations, song and nesting sites. The Chaffinch (*Fringilla coelebs*) was the most abundant of the song birds.

27. Report on the Redshank Inquiry 1939–40. J. F. Thomas. 1942. *British Birds*, 36 : 5–14; 22–34. A coöperative study of the British Trust for Ornithology on the spread and habits of *Tringa totanus britannica*. One hundred years ago it bred only on the eastern side of Great Britain on the seashore, tidal rivers and neighboring coastal districts; now it has spread over almost all of Great Britain.

28. Is It Wise Policy to Introduce Exotic Game Birds? Ralph T. King. 1942. *Audubon Magazine* (formerly *Bird Lore*), 44 : 136–145. Excellent presentation of the subject, pointing out the dangers of such introductions and emphasizing the far better alternative of improving conditions for our native species. The author shows that introduced game birds are expensive, and that they increase the hunting pressure on our native game; he discusses their general undesirability from the standpoint of spreading disease, weakening stock by crossing and competition. He quotes Grinnell that "when a species native to a large area is successfully introduced into a new small area the related species which is native in this area and with which the former comes into competition is soon supplanted," due to the superior toughness and aggressiveness of the foreigners (from Eurasia in contrast with North America). "One of the strangest things in connection with this matter of introductions is the blind faith exhibited by those who believe that they can keep exhausted coverts inhabited and productive by 'pouring' into them more birds to suffer the same fate suffered by those previously occupying the coverts. There seems to be no appreciation of the

relationship between range and populations."

See also Nos. 31 and 34.

BOOKS

29. Cuckoo Problems. E. C. Stuart Baker. 1942. Witherby. London 207 pp. 25 shillings. Based on investigations conducted "for nearly seventy years", during which a collection was made of some 6,000 Cuckoo eggs, half of them from Asia, this book deals primarily "with the evolution of the Cuckoo's egg." Much attention is given to the "Need for Adaptation of Cuckoo's eggs to Those of Fosterers." The incidence of desertion of nests parasitized by the Khasia Hills Cuckoo (*Cuculus canorus bakeri*) was 8 percent in 1642 cases with normal fosterers and 24 percent in 298 cases with abnormal fosterers. Experiments showing that less adapted eggs are more often rejected were made by Swynnerton and Ali. In Great Britain the eggs of *Cuculus c. canorus* are generalized to match the most common fosterers—Reed-Warbler, Meadow Pipit and Pied Wagtail; in Hungary the Great Reed Warbler is the most common host and the Cuckoo eggs are very similar. In Finland and Lapland a type has been evolved to match Brambling and Chaffinch eggs, and a bright blue egg for the Redstart and Wheatear. The Khasia Hills Cuckoo has six main types of eggs ranging from reddish brown speckles to a clear blue. Many instances of extraordinary adaptation to the hosts' eggs are mentioned, particularly with Asiatic Cuckoos; size as well as color is involved and the explanation would appear to be rejection by the hosts of eggs dissimilar to their own.

As to time of laying, with Cuckoos in India it may be early in the morning or in the afternoon (p. 169). Most Cuckoos lay at 48 hours interval, although some small species may lay every day; Mr. Baker believes that laying is continuous and that when the nests in one area are exhausted, the bird goes to another, returning later to the first place (p. 143). He does not mention Chance's findings in regard to the Cuckoo's watching the building of her victims some five days before laying her egg. The longest life for an individual Cuckoo was one in the Khasia Hills whose eggs were found between 1925 and 1936 (p. 9), or 1925 and 1935 (p. 169). Evidence is cited to show that female Cuckoos are often promiscuous; the author does not believe that the male has any influence on the eggs of his daughters. Female Cuckoos generally defend a territory from other Cuckoos parasitic on the same species, but tolerate females parasitic on other species; some species of Cuckoos do not hold territory. *Cuculus*, *Penthoceryx*, *Cacomantis* and *Chalcites* all evict other nestlings and eggs and all have as nestlings a "special conformation of the back which enables, or assists, them in carrying out the ejection" (p. 155). But *Clamator* and *Eudynamis* lack this cavity in the back and never evict their nest mates.

Curiously enough, the author suggests that since reptiles seldom build nests, "Evolution in nidification *must* have been acquired in the first place and parasitism seems to have been acquired not by birds which were originally nest-builders, but by those who had never acquired the art of nest-building" (p. 98). Yet he states, "Our most primitive Cuckoos (*Phoenicophainae*) are not parasitic, they make their own nests, hatch their eggs and rear their young" (p. 99). It is impossible for the reviewer to see how a bird with altricial young could always have been parasitic.

The Cowbird is dismissed with the statement that information on it is well summarized by Makatsch (1937); whereas almost nothing is given there. It would have been of great interest to contrast this successful parasite where no specialization has taken place in egg or young with Cuckoos that are so highly specialized. The book is illustrated with eight beautiful plates in color of eggs of different Cuckoos and their fosterers. There is no index and few references are complete. A valuable treatise on the evolution of Cuckoo eggs, but rather disappointing on many other intriguing problems of parasitism.

30. Watching Birds. James Fisher. 1940. Pelican Books. London. 6d. 192 pp. An excellent little book on field study of birds, concluding with practical suggestions on "What You Can Do." In the chapter on "The Number of Birds" the increase and spread of several species in the British Isles are noted—Fulmar, Greater Spotted Woodpecker, Tufted Duck, Grey Wagtail, Redshank, Curlew, Black-headed Gull and Oystercatcher. The May breeding population of the 57 million acres of Great Britain is estimated at 60 million pairs (p. 167). The author states that territories of "typical" territory birds range between one-half and four and a half acres. "The general advantage lies in the fact that territory ensures an *even distribution* of birds over an area, thus not stretching unduly the limits of food supply in any one place while neglecting the sources of food in another" (p. 172). The task of the protectionist is three-fold: "insure the continuance of certain areas in their present natural state so as to preserve a sample of bird life affected by man as little as possible"; "preserve different species of birds because of their population, interest, and biological importance as much as because of their rarity"; and "keep the collectors away."

31. Nesting Birds and the Vegetation Substrate. William J. Beecher. 1942. Chicago Ornithological Society. Field Museum. 69 pp. $1.00. An exhaustive study of upland-marsh ecology. In 1937 over 1,200 nests were located in accurately measured plant communities in a 482 acre tract near Fox Lake, Ill.; these are analyzed according to seasonal and vertical distribution, as well as distribution as related to floristic complexity and to plant communities. A helpful glossary of ecological terms is given in the introduction, and methods used in mapping areas and locating nests are described. The geological history of the area is discussed, followed by a detailed description of "present plant communities, particularly as their physical characteristics determine their substrate value to nesting birds. The breeding birds are then listed in systematic order with quantitative data covering the densities of each in all the plant communities in which they nested."

"A correction of the densities obtained in terms of the so-called 'edge effect' is next undertaken. It is demonstrated that population density increases directly with increase in number of feet of edge per unit area of the plant society or with the increasing floristic complexity of the environment in terms of communities per unit area."

"Quantitative data covering the breeding period of each species discloses that those species nesting earliest in spring are birds whose nests show them to be independent of vegetation of the year—the further conclusion being drawn that the simultaneous nesting of marsh birds is conditioned by the development of the vegetation. Thus, laying may be retarded by external conditions in spite of physiological maturity of the gonads" (pp. 65–66).

This little book is attractively bound and printed; it is a valuable contribution to our knowledge of succession in birds, of factors in nesting distribution and especially of the subject of "edge." It is a work of outstanding value, based on a tremendous amount of field work, well-planned and faithfully executed.

32. Forward the Nation. Donald Culross Peattie. 1942. Putnam's. N. Y. 281 pp. $2.50. Another of Mr. Peattie's inimitable re-creations of great personalities and great adventures in our pioneer days, this time the Lewis and Clark Expedition which claimed for us the Pacific Northwest. The heroes of the book are Thomas Jefferson, Meriwether Lewis and William Clark and their men, and its heroine is Sakajawea, the Indian woman who guided them. In contrast to the high daring, vision and devotion of these, we are shown glimpses of the selfishness and vain-gloriousness and final downfall of Napoleon Bonaparte and Josephine, for it was Napoleon who sold us Louisiana Territory. The characters and the country are vividly portrayed in unforgettable fashion. The only disappointment is that so little is told us of the new birds discovered! An absorbing and

true story of indomitable courage, a delight to read, and an inspiration to remember.

33. Needle to the North. The Story of an Expedition to Ungava and the Belcher Islands. Arthur C. Twomey. 1942. Houghton. Boston. 360 pp. $3.50. A tale of adventure, hardships and achievement against difficulties and dangers in the Far North. A midwinter trip was made by the help of Indians into the interior of Ungava to secure specimens of the unknown fresh-water seal; later the ice was crossed to the Belcher Islands in Hudson Bay and spring and summer spent there in collecting zoological specimens. Birds are frequently mentioned, but Indians and especially Eskimos play a larger role in the book. The Indians have fallen upon evil days since the passing of the caribou, but the Eskimos by hard work and high skills successfully cope with the hazards of their lives. The amazing abundance of life on the Belchers in the short summer is emphasized. Several items as to decoying are of interest. The Eskimo children decoy geese by honking (p. 210). When in a boat and ducks were seen, the children waved "their arms vigorously up and down with a flying motion", whistling "qui-hew"; they "would soon have the whole flock circling the canoe and almost alighting with us out of curiosity and excitement" (p. 236).

The coming of the first Canada geese was an occasion for great excitement. "The Eskimo grew fancy with long necklaces of the bird-bands that they strung together and wore. Most of the bands were printed Bible verses", having been applied at Jack Miner's refuge (p. 217). After the cobblestones around the harbor were white-washed in August, "snow geese and blue geese, flying overhead in formation, would almost immediately swing around in line and come sailing straight down, decoyed by the bright white circle of goose-like stones" (p. 291).

Some of the photographs are a great interest, but many give only general views, whereas one would prefer more close-ups of Indians and Eskimos. The book makes exciting reading, but would have benefited from judicious cutting.

34. Birds Around New York City. When and Where to Find Them. Allan D. Cruikshank. 1942. American Museum Natural History Handbook Series No. 13. 489 pp. $1.84. An excellent guide to southern New York State, northern New Jersey and all of Long Island, this book offers much of ecological and phenological value to bird students everywhere. Of most significance are the 22 pages devoted to "Our Major Ecological Blocks", where summer, spring and fall transient, and winter birds are listed under "Dominants" and "Sub-dominants." These blocks are: open ocean (two to ten miles out); ocean (from shore to two miles out); ocean beaches and sand dunes; coastal bayberry, high-tide bush and poison ivy thickets; salt or brackish marshes; coastal mud flats; sheltered salt water; fresh water; fresh-water marsh; disturbance communities; plains and dry fields; fields with bushes and scattered trees; second growth deciduous trees; mixed deciduous growth; great pine and oak barrens. The "Ornithological Year" is also of general importance; the contrast between early migrants, so dependent on the weather, and the later more regular migrants is pointed out. The February migrants "are not by any means as definite in their movements as those in May. Weather at this time is too powerful a factor and there may be almost a month's variation in their arrival according to season" (p. 36). As to May, "The movements during this month are much more precise than at any other time, some species arriving with almost the precision of clockwork. Naturally weather and temperature cause some, and occasionally considerable, variations. A wave is generally due to unfavorable weather damming up the birds moving northward for several days" (p. 39.)

The annotated list gives some account of the past and present status of each species in different localities in the region, of migration dates and behavior, and of nesting sites and dates. The criterion of abundance is "the highest count I have ever made in a day of vigorous birding (at least nine hours of active obser-

vation), . . . or the number one may expect to see during a day at a given season" (p. x). Maps of the region are given on the end papers and 35 splendid photographs of birds included. This is a notable coöperative effort, a monument to the activity and zeal of the field ornithologists of the New York City region.

35. Life Histories of North American Flycatchers, Larks, Swallows, and Their Allies. Arthur C. Bent. 1942. U. S. National Museum Bulletin, no. 179, pp. i–xi+555, 70 pll. A fascinating volume, full of interest and illustrated with remarkable photographs. Skutch's accounts of the Becard and Sulphur-bellied Flycatcher are notable. Most of the book is taken up with the Tyrannidae, and many interesting items are given. Many of them are belligerent not only to members of their own species but to others, especially to predatory birds. Tanagers, vireos and warblers nest near the nest of Coues' Flycatcher presumably for protection from hawks, jays and squirrels (p. 264).

Instances of more than two adults feeding young at one nest are given for Tree and Violet Green Swallows (pp. 378, 387). Bank Swallows on migration have been seen going into nesting holes of their kind to spend the night (p. 421). Cliff Swallows increased in the East as barns were built, then decreased because of competition from the English Sparrows. Now with fewer of these intruders in the East, they are again increasing, but in the West, English Sparrows are becoming more and more of a menace to the Swallows.

All bird students owe a debt of gratitude to Mr. Bent for his untiring efforts in compiling these Life Histories.

36. Shearwaters. R. M. Lockley. 1942. Dent. London. 238 pp. (Wm. Salloch, 344 E. 17th St., N. Y. C. $4.00). A fascinating book telling of the home life of the Manx Shearwater (*Puffinus puffinus puffinus*) at Skokholm—marked individuals which nested for many years, even up to 10 and 11, in succession. Some 10,000 of these birds nest on the island, but most of the information was obtained from an isolated group of a dozen burrows next Mr. Lockley's house. A piece of turf was cut from above the end of each burrow and removed and replaced at pleasure. Daily and nightly observations revealed an amazingly long incubation period of 51 to 54 days and an even longer fledging period of 72 to 74 days, incubation shifts of 3 to 5 days, occasionally twice as long during the time of full moon, feeding of the chick by regurgitation once each night by both parents except during moonlight, when it had to fast, and desertion of the chick by its parents some 12 days before it made its way by night to sea. Young birds picked up on this journey and released into the sea the following morning at once swam, drank, bathed and dove. Extensive ringing showed that fidelity to mates was the rule; the author suggests that voice serves as the means of personal recognition. It also showed that nesting birds range as far as the Bay of Biscay, 600 miles to the south. The extraordinary homing experiments where birds returned from many directions, even from points inland, and from Switzerland and Venice are described in detail. In an interesting discussion on age problems the minimum average life of a Manx Shearwater is calculated at six years. It is also estimated that 60% of the eggs laid produce independent young. The last chapters tell of explorations to Portugal and to islands of the coast of West Africa in search of different species of Shearwaters and Petrels.

A notable example of the fundamental value of banding in life history studies: for following the daily life of individuals during the nesting season, for studying migration and for experimenting on homing ability. The book is written with sincerity and charm; the chapter on "Adam and Ada" is a gem. There is a list of scientific names and an index, several maps and many excellent photographs.

Announcement

It is with great regret that *Bird-Banding* announces the resignation of Mrs. Margaret Morse Nice as Associate Editor.

Since 1934 Mrs. Nice has conducted in a most efficient and scholarly manner the section on Recent Literature which she developed into a most important feature of this journal.

Up to the date of publication, no successor to Mrs. Nice has been chosen. Until such a successor is announced, books and publications for review should be sent to the editor.

BIRD-BANDING

A Journal of Ornithological Investigation

(Published Quarterly)

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*Died April 7, 1942

UTION CHART